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ENTERING THE FIRST YEAR OF THE SEVEN-YEAR PLAN

S. M. Filippov

State Planning Commission, USSR

The development of the iron and steel industry in our country in 1958 took place under new conditions when the results of the industrial management reform carried out by the Party were already quite noticeable.

The plan for 1958 envisaged an increase in the production of pig iron by 5.4%, steel by 4.7%, rolled product by 3.6%, steel tubes by 7.7%, and iron ore by 3.8% compared with 1957. The workers of the iron and steel industry joined in the nationwide socialist competition to mark the occasion of the Twenty-first Congress of the CPSU and on December 27, 1958 completed the State Plan in all branches of the iron and steel industry.

In 1958, the output of pig iron in the USSR was 39.6 million tons, steel – 54.9 million tons, rolled product – 42.9 million tons, steel tubes – 4.6 million tons, iron ore – 88.8 million tons. More than 500,000 tons of pig iron, about 1.3 million tons of steel, nearly 1.2 million tons of rolled steel, more than 100,000 tons of steel tubes, and more than 1.5 million tons of iron ore were produced over and above the planned target.

The following figures (in % relative to 1957) illustrate the growth in the output of ferrous metals in 1958:

Iron ore	Pig iron	Steel	Rolled products	Steel tubes
105	107	107	107	110

In the Russian SFSR and Ukrainian SSR, the largest republics in the Union where the main industrial establishments of the iron and steel industry are located, the output plan for 1958 has been fulfilled in all the basic production branches. Owing to organizational and technical troubles at the Zakavkaz Works, the planned target of steel and rolled product in the Georgian SSR has not been achieved. The steel output of Azerbaidzhan and the Kazakhstan industries fell short of the target. Here too, this was caused by organizational and technical difficulties.

The increase in the output of ferrous metals in 1958 was achieved not only on account of the introduction of new units but also thanks to a further improvement in the utilization of the existing ones. The decisive factor in the fulfillment of the production plan and in the growth of the output of ferrous metals was a further improvement in techniques, production methods and organization, and, hence, a more efficient utilization of productive capacities.

In blast furnace production in 1958, the introduction of new, highly efficient production processes, and an improvement in the preparation and quality of raw materials were continued.

Sinter output was increased by 11% in one year (from 45.1 million tons in 1957 to 50 million tons in 1958). The basicity of the sinter increased considerably: it increased to 1.2 at the Makeevka Works and to 1.05-1.1 at the "Zaporozhstal'" Works; the production of a sinter of a basicity of 1.7-1.8 has been mastered at the "Azovstal'" Works.

At several works the blast temperature has been raised to 950-1000°C. Many blast furnaces were successfully operating at 1.3-1.5 atm gas pressure at the furnace top. All this made it possible to improve the ratio of the blast-furnace useful volume to the daily output and to bring its average value for the Union (for 11 months of 1958) to 0.77 as compared with 0.79 in 1957, and at the same time to reduce the consumption of coke per ton of conversion pig iron from 817 to 786 kg.

The blast furnace plant of the Cherepovets Works achieved good results in 1958. By using charge in which the ore portion consisted of 100% cooled and graded sinter of 1.15 basicity, by employing 1.5 atm or even higher gas pressure in the furnace top and 1000 °C or higher temperature of the blast, and by adopting other advanced techniques, in November, 1958, the blast-furnace operators at Cherepovets achieved a ratio of the blast furnace useful volume to the daily output of 0.64 at a coke consumption of 586 kg.

The blast-furnace operators at the Magnitogorsk, Kuznetsk and Nizhne-Tagil Combines, and at the Chelyabinsk, "Zaporozhstal'", Dzerzhinskii, Petrovskii, "Azovstal'", Zakavkaz and other works improved their performance indices considerably.

No improvement, however, took place at the blast-furnace plants of the Serov Combine, the Makeevka, Krivoi Rog and some other works.

The current idling periods of the furnaces in 1958, on an average for all works, remained the same as in the previous year and amounted to 0.9% of the nominal working time. At the same time, the idling periods at the Nizhne-Tagil and the Serov Combines constituted 0.4% and at the Magnitogorsk Combine 0.6%. The blast-furnace plants of the Zakavkaz, Petrovskii, Alchevsk and Dzerzhinskii Works are seriously lagging behind the leading establishments and have long idling periods (1.2%, 1.7%, 1%, and 1.1% respectively).

In steelmaking, oxygen for the intensification of the steelmaking process, and compressed air for the intensification of the fuel combustion and for the blowing through of the bath began to be applied more extensively, and the heat-resistant chrome-magnesite bricks began to be much more widely used in open-hearth furnaces. The weight of the heat has been increased at several plants, thanks in particular to the introduction of all-welded light ladles.

During 1958, the Bessemer plants at the works of the Dnepropetrovsk Economic Region used oxygen for blowing the metal from above.

The open-hearth plants of the Nizhne-Tagil Combine, the "Zaporozhstal'", and the "Azovstal'" Works attained very good results by adopting the use of oxygen. The effectiveness of oxygen application has been improved at the Chelyabinsk and the Dzerhinskii Works. But at the open-hearth plant of the Makeevka Works the application of oxygen still remains rather ineffective.

An increase in the productivity of the open-hearth furnaces at several works was retarded by the shortage of equipment for light-scrap baling. A poor quality (with respect to chemical composition and particle size) of the open-hearth ore caused production difficulties, especially at works in the South.

In 1958, work on perfecting the continuous casting of steel was continued.

The rise in the technical level and an improvement in the organization of production made it possible to achieve a further increase in the output of open-hearth furnaces. The average output per 1 m^2 of hearth area at specialized works of the iron and steel industry increased from 7.32 tons in 1957 to 7.56 tons in 11 months of 1958. The steel output per 1 m^2 of hearth area (in 11 months of 1958) at the Nizhne-Tagil, the Kuznetsk and the Magnitogorsk Combines was 9.35 tons, 9.05 tons, and 8.93 tons, respectively.

The fall in the idling periods of open-hearth furnaces from 11% in 1957 to 9.9% in 11 months of 1958 contributed to the over-all increase in steel output. The idling time at the Nizhne-Tagil, the Kuznetsk, and the Magnitogorsk Combines, and at the "Zaporozhstal'" Works constituted, respectively, 6%, 7%, 7.6%, and 8.6%.

Idling periods are still very high at the Chelyabinsk (13.7%), the Dzerzhinskii (11.9%), the Stalino (11.2%), the Zakavkaz (11.8%), and the Makeevka (10%) Works.

The over-all production quota of rolled steel and tube production has been fulfilled. However, the planned production quota of some scarce rolled products (light H-beams and channels, low-alloy-steel sections, large-diameter welded tubes) has not been achieved.

During 1958, work has been carried out on the modernization and mechanization of several rolling mills, on the improvement of techniques and the organization of production, on the introduction of automation and on the mastering and expansion of the production of new light sections and tubes. The modernization of the slabbing mill and the continuous plate mill at the "Zaporozhstal'" Works was completed, the medium-section mill at the "Dneprospetsstal'" Works was modernized and so were several other plants. This made it possible to increase the output of sections and tubes at the existing plant substantially and to exceed the production quota.

Capital construction in 1958 was given great impetus. The total sum of capital investments in the iron and steel industry increased in 1958 by 30% compared with 1957, and investments in industrial constructions increased by 37%.

The 1958 plan envisaged the construction of seven new blast furnaces. This task was successfully fulfilled. Lenin's Komsomol, which accepted the patronage of the construction work, contributed greatly to the success. The new furnaces have a total capacity of 4.9 million tons of pig iron per year, inclusive of the blast furnaces at the Chelyabinsk Metallurgical Works and the "Krivorozhstal'" Works with an annual capacity of about one million tons per furnace.

Substantial new capacities were introduced in steel production and rolled steel production. New open-hearth furnaces in the Lugansk, Orenburg and Vologda provinces, electric furnaces at metallurgical works in the Chelyabinsk province and a converter in the Dnepropetrovsk province were put into operation. A new blooming mill and a continuous billet mill were introduced at the "Krivorozhstal'" Works, and the construction of the blooming mill at the Cherepovets Works was completed. Facilities for making large-diameter pipes were extended.

The productive capacities of the iron ore industry in the Urals, the Kazakh SSR, and Central Russia were substantially increased. A few large mines for mining rich ores in the Krivoi Rog Basin, and a large open-pit mine at the Kerch iron-ore deposit were put into operation. Nine sintering machines were put into operation. In particular, one should mention the starting of the sintering plant at the Lebyazh'e mine – raw material supplies to the Nizhne-Tagil Combine being thus improved.

One has to note, however, that the plan with regard to the introduction of some units among the capital constructions in 1958 has not been fulfilled. Thus, the plan with regard to the introduction of a new rolling mill has not been fulfilled. The main cause was a delay in the delivery of the equipment. In spite of good work done by the constructors and fitters, some of the rolling mills were not put into operation in 1958 because the delivery dates for some parts of the equipment were not kept.

The introduction of some steelmaking plants was also delayed. The construction of some mines and other units is behind schedule.

In 1959, our metallurgists are faced with great tasks. A further expansion in the production of pig iron, steel rolled sections, steel tubes, iron ores and other goods must be ensured.

Compared with the past year, the output of pig iron should increase by more than 3 million tons in 1959, steel – by more than 4 million tons, rolled products – by more than 3 million tons, and steel tubes – by more than 500,000 tons.

In order to ensure the fulfillment of the plan with regard to the introduction of new production units, it

is essential to concentrate materials and money as well as manpower on the most important constructions and plants to be put into operation this year. The time for the construction must be reduced to a minimum and, therefore, an early setting-up of industrial bases for the construction organizations, especially in the eastern regions, must be ensured.

When drawing up the production plans for 1959 as a whole and for separate quarters at industrial establishments and construction undertakings, one has to consider the delivery date of goods to the customers, as well as the maximum possible utilization of the productive capacities over the whole year.

To improve a planned production at industrial establishments one should avoid frequent changes in the quarterly and monthly plans. In 1959, the quarterly plans may be changed, if necessary, not later than 45 days before the end of the quarter, and monthly plans not later than 20 days before the end of the month.

In the current year more attention must be paid to the quality of the product. We have to achieve a higher rate of productivity increase than the rate of wage increase, to tighten the control on the adoption of technically justified planned rates of output, to revise obsolete and too-low rates of output, and to ensure an economic expenditure from the renumeration fund and from other funds assigned to industrial establishments.

In order to ensure that teenagers and young people coming out of secondary schools and industrial training schools are taken into industry, all industrial establishments and organizations should allot a quota of places for these youths to work and undergo industrial training.

In 1959, the technical level of the metallurgical industry will rise considerably owing to improved technology and a further mechanization and automation of industrial processes. As in past years, an improvement in the preparation of raw materials for the blast-furnace process will be receiving a great deal of attention, the output of the sinter will increase considerably and its basicity will be raised. The existing blast furnaces at several works will be adapted to operate at a higher gas pressure in the furnace top. At new furnaces, operation at up to 1.5 atm or higher gas pressure must be mastered. At several works the temperature of the blast should be increased. In this connection, research and development work on the progressive modernization of air stoves must be continued. A general reduction in coke consumption per ton of pig iron, and the utilization of pyrite cinders, blast-furnace dust, and other iron-containing industrial waste in the initial material for sinter production, are all of great importance.

The work on the application and more effective use of oxygen in the steelmaking process will be continued. At several plants, where it is economically justified, compressed air will be used for the intensification of the steelmaking process. It is very important to provide for an extensive replacement of the riveted steel-pouring ladles by the lighter all-welded ladles.

In 1959, we must turn our attention very seriously to the preparation of the metallic charge for open-hearth furnaces, and, therefore, works will have to be equipped with powerful machines for the preparation and baling of scrap.

New, more durable, refractory materials for the converter lining must be used at the Bessemer plants which employ oxygen blast for pig iron. Also, metal losses during the smelting and pouring of steel must be reduced and the process must be made more economic.

In rolled steel and tube production we should master and increase the output of new, economic and, in particular, reduced-weight sections and tubes. At the same time, the work on the modernization of rolling mills, on the improvement of heating facilities, on the mechanization and automation of production, and on the intensification of the processes of reheating and rolling the steel, must be continued throughout 1959. It is very important to extend the work on the mechanization of the sorting, and in particular, of the finishing operations on rolled product.

In spite of substantial improvements in 1958, some establishments are still lagging behind the leading works with respect to the utilization of the productive capacities of the plants. Hence it is essential to study and adopt the advanced techniques of leading workers and teams, and to improve production methods.

The capital investment into industrial constructions in 1959 should be increased by almost 33%. An especially large increase will be in capital investment for the construction of ore mines.

The introduction of new units is envisaged mainly at existing establishments. The productive capacity of the Cherepovets, Krivoi Rog, Novolipetsk, Alchevsk, and other works will be considerably increased. The construction of new works – the West Siberia Works and the Karaganda Works – will go ahead at full speed.

The measures which are being worked out by the economic administration with a view to ensuring the completion of the planned tasks in all industrial establishments and construction projects, to revealing and utilizing the internal potentialities of the expansion of production in the national economy, to increasing productive efficiency and to reducing the costs of production and turnover, should contribute greatly toward the fulfillment of the 1959 production plan. A systematic control on the progress toward the fulfillment of the 1959 plan should be established and operative assistance for the National Economic Councils and industrial establishments in their everyday work should be organized.

The workers of the iron and steel industry, inspired by the grand program for the establishment of a communist society, will continue the competition on an even larger scale and will more than fulfill the 1959 plan. Thus, firm foundations will be laid for the fulfillment of the Seven-Year Plan.

PRODUCTION OF NODULES FROM THE CHARGE CONTAINING PYRITE CINDERS

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Pyrite cinders from the chemical works in the Urals contain not more than 45-50% iron and 16-25% silicon. In addition, they contain copper and zinc. The introduction of unbeneficiated cinders into blast-furnace charge is accompanied by a deterioration in the technical and economic indices of the blast-furnace process. It is, therefore, of interest to select an economic method of compacting the pyrite cinders and, thus, possibly to reduce the negative effect of the introduction of cinders into the charge.

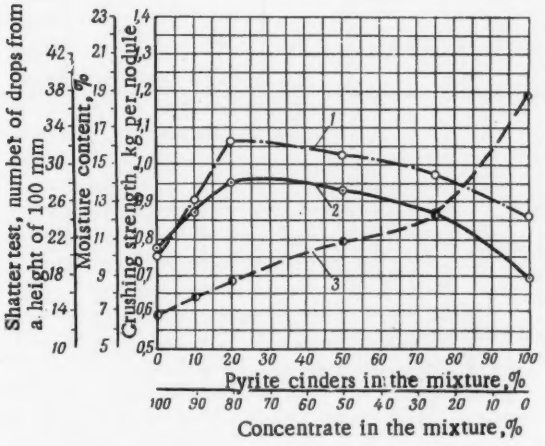

Shatter test, number of drops from a height of 100 mm
Moisture content, %
Crushing strength, kg per nodule
Pyrite cinders in the mixture, %
Concentrate in the mixture, %
1
2
3

Fig. 1. Properties of unroasted nodules made from the mixture of pyrites and concentrate: 1) crushing strength; 2) shatter test (number of drops from a height of 100 mm); 3) moisture content.

Until now pyrite cinders were used as additions to the charge materials at sintering plants. The sinter obtained from such a charge has a somewhat lower mechanical strength and reducibility, as is shown by the operational experience of the Cherepovets Works.[1] In addition, when pyrite cinders are used in the charge, the output of the sinter machine is considerably reduced. There is reason to think that it is more economic to use pyrite cinders for the production of nodules. Obviously, only fluxed pyrite nodules can compete with fluxed sinter.

A study[2] of the feasibility of producing fluxed nodules from ore mixture with pyrite cinders and the comparison of this method with the sintering process was carried out at the NTMC.

The Vysoka-Gora magnetite concentrate 0-0.21 mm in size, and Ural Works cinders stored for several years in the open, were used for nodule production. The Lebyazh'e limestone of various particle sizes served as the fluxing addition. Data on the chemical and size analyses are given in Table 1.

A plate granulator, 1000 mm in diameter, rotating at 12 rpm, was used for compacting the material. Mixtures of concentrate and cinders, as well as concentrate and cinders separately, were subjected to compacting. All the materials were fluxed, up to 1.0 basicity, with finely ground limestone. The strength of the unroasted nodules produced depended on the cinder content in the charge (Fig. 1). Nodules obtained from the charge which contained about 20% cinder had the highest mechanical strength. It is obvious that with this composition of the charge, the most compact packing and the best bonding between the ore particles are obtained.

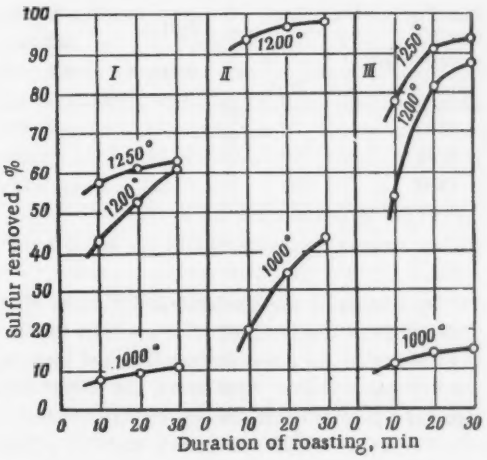


Fig. 2. The efficiency of the sulfur removal as a function of the basicity and the temperature of roasting: I) fluxed pyrite cinders; II) nonfluxed pyrite cinders; III) fluxed mixture of 80% concentrate and 20% pyrite cinders.

[1] Metallurgist No. 6, 1958. See C. B. translation.

[2] The investigation was carried out in cooperation with the chief engineer of the NTMC, S. V. Makaev; I. D. Paterin and E. A. Pakhomov took part in the work.

TABLE 1. Chemical Composition and Size Analysis of the Material

Material	Chemical Composition							Size analysis, %				
	Fe	FeO	S	Cu	Zn	SiO_2	CaO	+0.21 mm	0.150-0.21 mm	0.105-0.150 mm	0.074-0.105 mm	0.074 mm
Pyrite cinders	52.3	7.5	1.45	0.22	0.27	17.4	2.8	6.4	6.3	16.4	18.6	52.3
Concentrate	59.3	25.8	0.19	0.23	0.08	7.2	3.2	15.3	19.7	14.8	15.0	35.2

TABLE 2. Properties of Fluxed Unroasted Nodules Made of a Mixture of the Concentrate (80%) and Pyrite Cinders (20%)

Size of limestone particles	Chemical composition of the mixture			Moisture content %	Crushing pressure, kg per nodule		Number of drops from a height of 100 mm	Yield after the drop from a height of 1 m, %			Remarks
	Fe	SiO_2	CaO		moist	dry		whole	with cracks	crumbled	
0-1.0	52.36	6.27	6.74	8.4	0.63	—	13.1	10	50	40	
0-0.5	52.24	7.04	7.04	8.6	1.06	2.02	26.1	50	30	20	With calcined lime
0-0.5	53.02	6.67	6.67	10.4	0.82	2.53	12.9	40	30	30	
0-0.5	52.66	6.93	6,82	10.8	1.07	3.97	29.9	70	20	10	With milk of lime

TABLE 3. The Oxidation of Fluxed Nodules after Roasting

Conditions of roasting		Pyrite cinders	Mixture: 80% concentrate, 20% pyrite cinders
temperature, °C	time, min		
1000	20	1.70	1.82
1200	20	0.96	0.76
1250	20	1.07	2.96

By comparing the mechanical properties of nodules obtained from materials of various screen analyses one can verify that the finest materials do not always produce the strongest nodules. Apparently, the proportions of the separate fractions constitute an important factor.

A mixture of 80% concentrate and 20% pyrite cinders was used primarily in the investigations. The effect of factors such as the size of the limestone particles, and the replacement of a part of the limestone by calcined lime and milk of lime, on the properties of unroasted nodules, was studied. The experimental results are given in Table 2.

It is seen from Table 2 that the introduction of milk of lime improves the strength of the nodules, in particular of the dry ones. It is interesting to note that with the increase in the fraction of pyrite cinders in the charge, the strengthening of the milk of lime becomes more pronounced. When the pyrite cinders are compacted without the concentrate, the introduction of the milk of lime results in an almost threefold increase in the number of drops from a height of 100 mm which are withstood by the nodules. The introduction of calcined lime reduces the strength of the nodules in all cases, just as does the introduction of limestone of larger size particles.

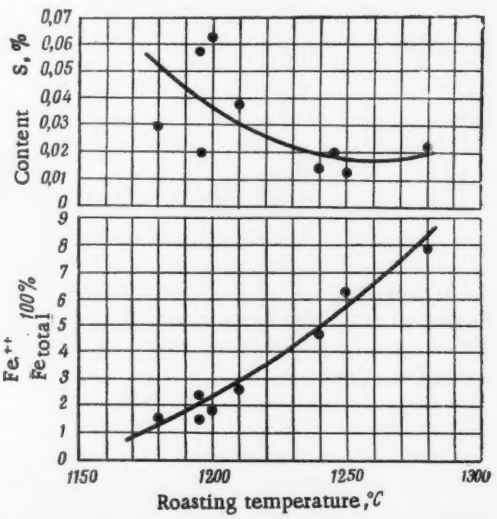


Fig. 3. The oxidation of nodules and the sulfur removal as functions of the temperature of roasting.

The nodules were roasted in an air atmosphere, in a laboratory furnace equipped with a silicon carbide

TABLE 4. Properties of Roasted Nodules and of Sinter

Characteristics, %	Nodules	Sinter
Chemical composition:		
Fe	54.02	53.74
FeO	3.81	14.40
CaO/SiO_2	0.93	0.91
S	0.044	0.080
Ratio $\frac{Fe^{++}}{Fe_{total}} \cdot 100$	5.46	20.84
Reducibility*	53.0	38.3
Degree of reduction after sinter and nodules had been kept in the blast furnace.	40.1	9.1
Screen analysis after sinter and nodules had been dropped six times from a height of 2 m:		
+10 mm	80.2	48.8
5-10 "	15.8	31.8
3-5 "	1.7	7.3
0-3 "	2.3	12.1
Screen analysis of nodules, kept beforehand in water, after they have been dropped six times from a height of 2 m.		
+10 mm	78.5	-
5-10 "	7.5	-
3-5 "	6.7	-
0-3 "	7.3	-

*By the MMK method

heating element, and in a cup, 150 mm in diameter, with downdraft (kerosene was used as fuel for roasting the nodules in the cup). The experiments in the silicon carbide furnace showed that sulfur is ineffectively removed from fluxed (up to 1.0 basicity) pyrite cinders even at 1250°C when the material begins to melt (Fig. 1). It is not possible to raise the temperature of roasting further. Nonfluxed pyrite cinders lose practically all their sulfur at as low a temperature as 1200°C.

This difference in the process of the desulfurization of fluxed and unfluxed pyrite cinders can be explained by the presence in the cinders of a large amount of $CaSO_4$ which decomposes with difficulty even at a temperature of 1400°C. A high silicon content in the nonfluxed nodules apparently facilitates dissociation according to the following equation:

$$CaSO_4 + SiO_2 = CaSiO_3 + SO_3.$$

When limestone is added, there appears in the nodules a fairly uniformly distributed lime which combines with silicon and hinders the desulfurization. This fact is confirmed by the data on the removal of sulfur from the mixture of the concentrate with pyrite cinders. Here, the sulfur removal is extensive since the fluxing of the pyrites requires less limestone and the contact area between the lime particles and pyrites is smaller.

The degree of desulfurization depends largely on the duration of roasting. In order that a sufficiently low sulfur content be achieved the duration of roasting should be at least 20 minutes.

The degree of oxidation on nodules was calculated from the formula

$$\frac{Fe^{++}}{Fe_{total}} \cdot 100\ \%.$$

Data on the degree of oxidation of nodules are given in Table 3.

Fluxed nodules made up of 80% concentrate and 20% pyrite cinders were roasted in the cup. It is seen from Fig. 3 that, with the increase in the roasting temperature, the sulfur content in finished nodules decreases but, at the same time, the ferrous oxide content decreases and, hence, the reducibility deteriorates.

As a result of the experiments, the following optimum parameters of the roasting process were established: temperature 1210-1240°C, duration 20 min. During the roasting it is essential to maintain the temperature within the limits given above. If this condition is not satisfied an excessive fusion of the nodules or an inadequate desulfurization results.

Test batches of the sinter and of nodules, made from the mixture indicated, were prepared for the purpose of comparing their metallurgical properties. In addition to the usual tests, the change in the mechanical strength of nodules after they had been kept in water for 20 hr was investigated.

The behavior of the nodules and of the sinter in the blast furnace was investigated by means of probing; for this purpose, batches of material, 100 g in weight, were placed in a basket attached to a steel tube and were lowered together with the charge into the furnace to a depth of 8 m below the stock level. The basket was then taken out, the material was chemically analyzed and, hence, the degree of reduction was calculated. The results of the tests are given in Table 4, which shows that the metallurgical properties of the nodules are better than those of the sinter.

Hence, it may be expected that by the introduction of pyrite cinders in the form of nodules into the blast-furnace charge the technical and economic indices of the blast-furnace process will be affected to a lesser extent then by the use of sinter made with the addition of pyrite cinders.

THE AUTOMATIC DETERMINATION OF THE COMPOSITION OF PERIPHERAL GASES IN THE BLAST FURNACE AND THE CONTROL OF THE BLAST-FURNACE OPERATION

Z. I. Nekrasov and Ya. M. Obodan

Institute of Ferrous Metallurgy, Academy of Sciences, Ukrainian SSR

The Institute of Ferrous Metallurgy of the Academy of Sciences, Ukrainian SSR, developed an apparatus for the continuous sampling, fixing, and fine filtration of samples of the peripheral gas in the blast furnace, as well as for the automatic analysis and recording of the chemical composition of the gas. The apparatus[1] was put into operation and has been in use at the Dzerzhinskii, Petrovskii and other works for a long time.

Description of the Apparatus. The apparatus consists of a stabilizer, a filter, an embrasure with a stopcock and stuffing box, a gas line, a bubbling liquid seal, an automatic gas analyzer, a thermocouple, a pulse lead, and a temperature recorder. Usually, several such instruments are installed at the furnace to provide for the automatic analysis of gas composition at 4 to 8 points symmetrically distributed on the circumference of the blast furnace under the guard segments.

The stabilizer, equipped with a filter, is inserted into the opening made in the lining and shell of the upper part of the shaft in such a way that one end of the stabilizer comes flush with the inner surface of the lining (Fig. 1). The stabilizer is a chamber with hollow walls formed by two concentric tubes welded at the ends; a third tube is welded into the annular space and serves for the delivery of water at a high rate to the intake orifice. In this way, the true composition of the gas at the entry to the stabilizer is fixed. For the purpose of reducing the fouling, the inner tube has a hole at the end near the working space of the furnace. In the outer part of the inner tube there are two stopcocks; one for cleaning the fixer by means either of mechanical scrubbing or compressed-air blowing, and the other for attaching the filter.

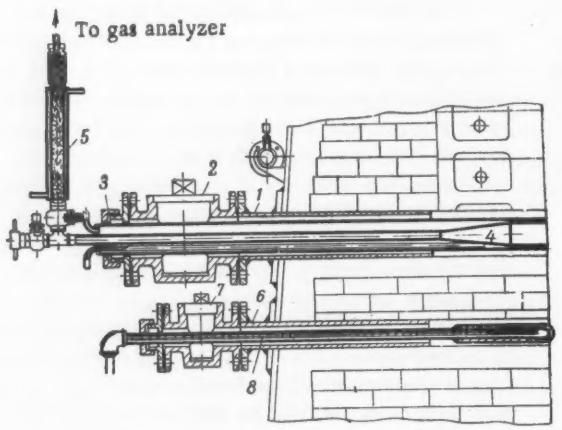


Fig. 1. Method of mounting the stabilizer and the thermocouple: 1) embrasure of the stabilizer; 2) stopcock; 3) stuffing box; 4) stabilizer; 5) filter; 6) embrasure of the thermocouple; 7) stopcock; 8) thermocouple.

The filter is a cartridge with several layers of filtering materials which ensure a multistage dust removal from the gas. The lower part of the filter contains a 100 mm high porcelain packing (hollow porcelain cylinders); above it, there is a 400-500 mm thick layer of coke (5-7 mm particle size). A layer of cotton wool or glass wool serves for the removal of semifine particles from the gas. The final purification of the gas is effected by a ceramic filter consisting of several porous-fireclay rings separated by rubber gaskets and mounted in the cartridge with a fastening attachment to allow the gas to pass through the ceramic material only. Such a construction of the filter ensures that efficiently cleaned gas continuously enters the automatic gas analyzers accommodated in the control room and equipped with recording drums and clock mechanism.

The openings for the thermocouples are made 0.3-0.4 m below the gas-sampling openings. A solid heat-resistant steel cap, 2-2.5 inches in diameter, is welded onto the thermocouple sheath in order to increase its service life. The thermocouple readings are recorded on a chart of the recording potentiometer.

In addition to the samples of peripheral gas, a sample of the total gas is taken by means of a similar stabilizer and filter mounted in one of the dust catchers where the gas is already adequately mixed and can be considered to be of uniform average composition.

The apparatus operates as follows. A portion of the peripheral gas moving down the walls of the blast furnace enters the cooled fixer, one inch in diameter. There, the gas is quickly cooled (its true composition is thus fixed),

[1]The apparatus was proposed by Z. I. Nekrasov, Corresponding Member Acad. Sci., Ukrainian SSR. A large number of blast-furnace workers in the South contributed toward producing and improving the apparatus.

passes through the filter, where it is cleared of dust, and is then taken by the gas line to the control room. Here a part of the gas goes to the gas analyzers, and the remainder (actually the main bulk) passes through the liquid seal and then through a flare into the atmosphere.

The gas pressure is controlled by means of a valve in front of the gas analyzer. To ensure that the readings of the instrument correspond to the actual composition of the gas passing the sampling point at a given time, one should adjust the gas flow in such a way that the volume of the gas going through the flare into the atmosphere between two subsequent analyses (i.e., in 2.5-3 minutes) should at least be equal to the volume of the total gas line from the sampling point to the analyzer.

Control of the Blast-furnace Operation. It was found by a few years experience on the use of the apparatus for the automatic analysis of the peripheral gases at the blast furnaces of the Dzerzhinskii, Petrovskii, Krivoi Rog, Voroshilov and other works that the basic characteristics of blast furnace operation, i.e., the output and the coke consumption, are better when

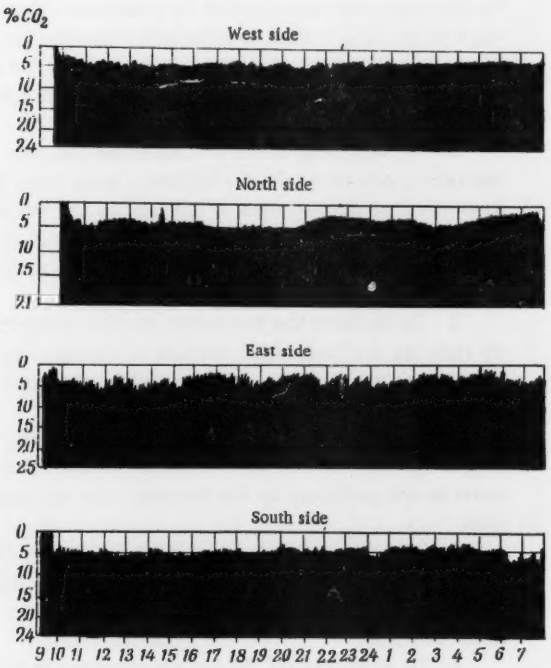


Fig. 2. Charts of the CO_2 content in the peripheral gas at a steady operation of the furnace.

the content of CO_2 in the peripheral gas is higher while at the same time there is an increase in the over-all CO_2 content in the total gas. The CO_2 content should be as high as possible and not less than 7-7.5%. Only when the charge of the blast furnace contains considerable quantities of fines may the CO_2 content in the peripheral gas be lower.

An abnormally low CO_2 content may be due to an irregular distribution of the charge in the furnace top, a considerable erosion of the lining or an overburdening of the central zone of the hearth caused by conditions of charging, water ingress, unsuitable blast regime and other factors.

With a normal operation of the blast furnace, distinguished by a steady descent of the stock and a correct distribution of the charge materials and the gas stream, and when the internal contour of the furnace is not distorted, the graph on the chart for the CO_2 content in the peripheral gas should be approximately a straight line (Fig. 2). The difference in the CO_2 content at different sampling points should not exceed 1-1.5%.

Any increase in this difference indicates that the furnace has begun to operate more or less irregularly, because of the irregular functioning of the charging equipment, disproportionate volume of the skip (or the charge materials in it) to the volume of the revolving distributor, distortion of the internal contour of the furnace due to incrustations on or erosion of the lining, irregular descent of the stock (hanging, slips, scaffolding), unsuitable blast regime (including a nonuniform distribution of the blast in the tuyeres).

If the composition of the gas stream becomes nonuniform one should check the charging apparatus and eliminate any defects in it and any irregularities in the furnace charging. It is essential to check, first of all, whether the operation program of the revolving distributor is accurately executed, that the distributor does not begin to turn before all the material has been discharged from the skip, and whether the small and large bells are properly aligned. One should also check if the volume of the distributor hopper is of suitable size in relation to the volume of the skip when the latter is fully loaded. A right distribution of the materials in the skips and an odd number of the skips in a charge is of great importance.

Any defect detected should be eliminated immediately. If 8-10 hr after the elimination of the defects, the composition of the peripheral gas in the furnace is still nonuniform, one must take additional corrective measures since any delay in the elimination of irregularities in the furnace operation may not only affect the efficiency of the process but also cause the formation of incrustations or a one-side erosion of the furnace lining.

For the elimination of channeling or of a nonuniform operation of the furnace, the following measures are recommended:

1. To change the system of charging (a temporary change to a type of rounds which give a smaller amount of ore on the periphery of the stock; charging the ore materials in waves toward lower CO_2 contents by means of appropriately varying the cycle of the revolving distributor operation; charging 2 or 3 ore-free rounds and subsequently making up the deficiency of the ore depending on the thermal condition of the furnace).

2. To improve temporarily the size composition of the charge (replacing fine ores with lumpy ores).

3. To lower the stock by reducing the blast pressure to 0.2 atm, and then to charge the furnace additionally while it is being fanned.

If the nonuniform composition of the gas is caused by irregular furnace operation (a difficult descent of the charges, pronounced fluctuations in the gas pressure at the top, scaffolding and hanging, drawing in of ramrods, slips, excessive dust carryout) one should:

1) temporarily change the method of charging (start charging "coke first" and raise the stock line by 0.25-0.5 m);

2) increase the ore burden if the temperature in the furnace remains high for a prolonged period of time;

3) change the blast regime according to the current technological instructions;

4) improve the slag composition (if its basicity is abnormal) and make it as stable as possible and sufficiently fluid;

5) improve the quality, coke screening, and particle-size composition of the iron-containing portion of the charge.

As a rule, all these measures should be applied in the sequence given here: if the first measure proves ineffective, the next one should be tried, and so on, until a uniform composition of the peripheral gas is achieved. If, however after the elimination of any defects in the furnace charging and after the application of measures for the elimination of channelling and nonuniform operation, pronounced differences in the CO_2 content of the peripheral gas at different sampling points still persist for some days, it is an indication of the formation of incrustations on the furnace lining.

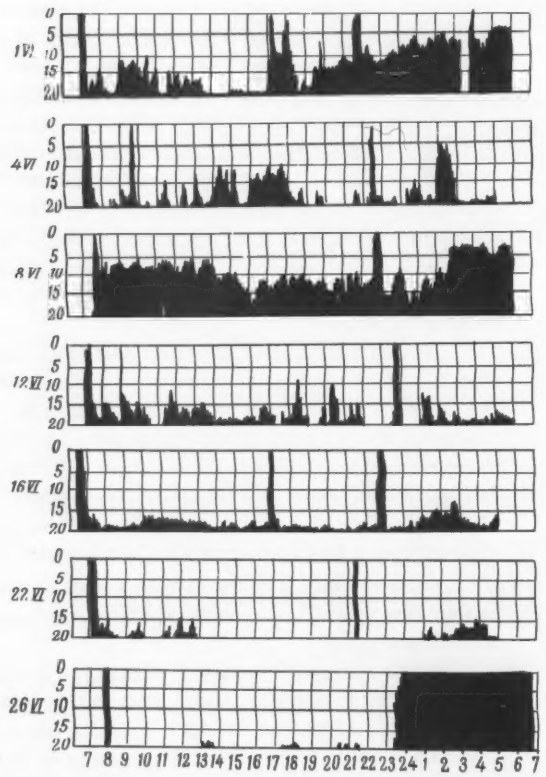


Fig. 3. Charts of the CO_2 content in the peripheral gas when incrustations have formed in the furnace.

The incrustations reduce the volume of the furnace, interfere with the smooth descent of the stock, and with the regular distribution of the charge materials and gas stream. Once formed, an incrustation grows quickly. Therefore, when incrustations are detected in the furnace one should, without delay, take steps toward their elimination.

From the CO_2 content in the peripheral gas it is possible to detect in time the formation of incrustations. Fig. 3 shows the charts for the composition of the peripheral gas at the north side of one of the blast furnaces at the Petrovskii Works. This form of graph indicates that the incrustation has formed in the furnace. A high CO_2 content in the gas where the incrustation has formed is, as a rule, also accompanied by pronounced fluctuations in the CO_2 content of consecutive samples from a given sampling point of the peripheral gas. At the same time, the CO_2 content chart for the furnace side which is uneffected by incrustations remains normal.

At the beginning of the process of incrustation formation, one may take the following steps which prevent a further development of this process and can sometimes restore the distorted contour of the furnace by removing the incrustation while the furnace is in operation.

1. To increase the peripheral gas flow temporarily by applying the "coke first" method of charging, by increasing the charges, and by distributing the coke preferably on the side of the incrustation.

2. To concentrate the charging of the welding slag manganese ore and predominantly ferrous-oxide sinter on the periphery by the first skip onto the large bell.

3. At the blast furnaces where high-basicity, fluxed sinter is not used, one may reduce the amount of limestone on the periphery by charging it in an extra or in the last skip.

4. To partly cut off the coolers temporarily in the places where the incrustation is suspected.

5. To weaken the adhesion of the incrustation to the lining by charging water to the spot where the incrustation adheres to the brickwork and then apply several consecutive forced slips.

A levelling-off of the CO_2 content in the peripheral gases on the whole periphery of the furnace and a steady descent of the charge indicate the removal of the incrustation. If, however, all these measures do not result in the removal of the incrustation, the furnace must

be shut down without delay and the incrustation removed by blasting. Experience shows that the time lost on the shutdown of the furnace can be made up quickly when the contour of the furnace lining is restored.

Before the incrustation is blown off, the contour of the incrustation must be outlined so that its dimension and the level to which the stock has to be blown out are determined. To do this, one needs only to measure the thickness of the lining and the incrustation through a number of check holes placed in a staggered pattern and these holes should be provided at various heights of the furnace for this purpose. Some of the holes should be in a vertical line with the stabilizers for sampling the peripheral gas.

Incrustations in the upper and middle part of the furnace are often a continuation of the incrustations at a lower level. Therefore, the furnace should be blown out as extensively as possible so that no roots on which new incrustations might begin to form are left.

An over-all lowering in the CO_2 content in the peripheral gas may occur as a result of an excessive reduction in the ore charge or a too extensive development of the peripheral stream of gases. If, at the same time, the CO_2 content in the total gas decreases too, the efficiency of the process is reduced.

Such a decrease in the CO_2 content of the peripheral gases is explained by the fact that the given charging system is not suitable for the changed particle-size composition of the ore portion of the charge, that the predetermined stockline was not maintained, or that the central section of the furnace became too dense as a result of overburdening that section with ore (in that case, the CO_2 content at the central line of the furnace will increase markedly).

The causes of the decrease in the CO_2 content may also be an excessive wetting of the charge materials (this is accompanied by the material sticking to the bells) or an irregular slag regime in the furnace.

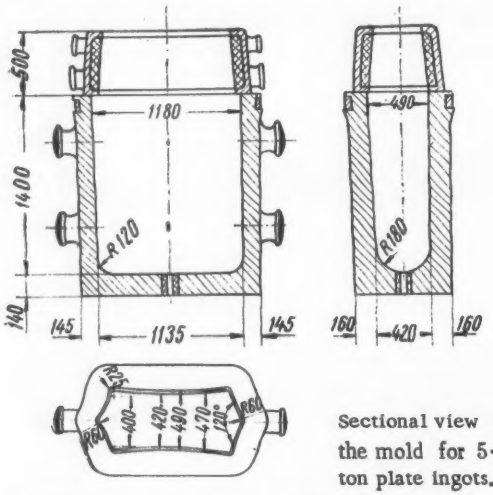
When all these causes are eliminated by means of the methods described above (changing the method of charging, the stockline, the slag and blast regimes, etc.), the furnace will begin to go evenly again.

RAPID FILLING OF THE HOT-TOP OF PLATE INGOTS

G. A. Chikalenko and T. I. Oleshkevich

The technological instructions on steel pouring usually specify that up to 1/3 of the height of the hot top is filled at the same rate as the ingot body and then the rate pouring is reduced so that the total time for filling the hot top should be at least half the time required for filling the ingot body.

When the ingots are bottom-poured this method of filling the hot top has substantial disadvantages. Owing to the reduced rate of pouring, the hot top receives the colder metal, and the lower part of the ingot is found to be contaminated to a greater degree than usual with oxide inclusions which are at first deposited on the walls of the runner and then may be caught by the stream of metal and dragged into the mold. Hence, it seems that the filling of the hot top at the same constant rate as the filling of the mold may have certain advantages.



Sectional view of the mold for 5-6 ton plate ingots.

Such a method of filling the hot top was tried out when 35 trial heats of St. 3 steel were poured. The dimensions of the mold for 5-6 ton ingots are shown on the diagram. For comparison, we took ingots of the same weight (from approximately the same number of heats as the St. 3 steel produced at the same period) with the hot tops filled according to the existing instructions. The time of filling the body of the ingot was practically the same for both groups of heats and varied within the range of 4.5-6 minutes. In the first case the hot top was filled in 25-30 secs, and in the ordinary method the hot top was filled in 1 min 40 secs to 2 mins.

The steel was made by the scrap-ore method in medium-capacity basic open-hearth furnaces with chrome-magnesite roofs. The temperature (measured by means of immersion thermocouples) of the metal before deoxidation in the furnace was 1645-1660°C. Steel was poured through a nozzle, 40-45 mm in diameter, into molds arranged in fours on one bottom plate. The fountain runner was made of thick brick with an inner channel 50 mm in diameter. The surface of the steel in the hot top was covered with the lunkerite consisting of 45% ground firebrick and 55% small coke. The firebrick was ground down to a maximum particle size of 5 mm and coke to a maximum size of 8 mm.

Comparative data on the surface quality of the large sides of the ingots poured by different methods (different procedure of filling the hot top) are given in Table 1.

It is seen from Table 1 that the ingots of the two groups compared do not differ significantly from each other with respect to their surface condition and, in particular, with respect to crack defects on the surface. This result is not unexpected, since the changes in the

TABLE 1. Surface Quality of 5-6 ton Ingots with Hot Tops Poured by Two Different Methods

Method of filling the hot top	Number of ingots	Number of inspected large sides of ingots	Out of this number									
			without defects		with defects							
					longtidunal cracks		transverse cracks		refractory inclusions		folds	
			number	%	number	%	number	%	number	%	number	%
Constant rate of pouring (the same rate as for the body of the ingot)	293	586	368	6.27	88	15.0	105	18.0	22	3.8	3	0.5
Reduced rate of pouring after 1/3 of the hot top has been filled	274	548	367	66.9	75	13.7	83	15.2	23	4.2	-	-

TABLE 2. Quality of the Plates Rolled from 5-6 ton Ingots with Hot Tops Poured by Two Different Methods

Method of filling the hot top	Number of ingots rolled into plates	Primary inspection. Plates rejected because of defects of metallurgical origin		Out of the total number rejected there were:											
				plates with longitudinal cracks		plates with transverse cracks		seams		scabs		refractory inclusions		folds	
		number	%	number	%	number	%	number	%	number	%	number	%	number	%
Constant rate of pouring (the same rate as for the body of the ingot)	301	78	25.8	8	2.65	20	6.60	33	10.9	6	2.0	5	1.65	6	2.0
Reduced rate of pouring after 1/3 of the hot top has been filled	285	92	32.11	9	3.3	10	3.65	63	22.2	5	1.85	1	0.37	2	0.74

TABLE 3. Number and Location of Seams on the Edges of the Inspected Plates

Location of the seams on the plate edges	Amount of plates with seams, % of total number of plates inspected	
	the same rate of filling the hot top and the ingot body	last 2/3 of the hot top filled at a reduced rate
Top edge	1.98	8.1
Bottom edge	2.65	6.70
Side edge	6.27	7.40
Number of plates inspected	301	285

method of pouring were made only with respect to the upper part of the hot top.

After the experimental ingots were rolled into 30-40 mm thick plates, the surface and the trimmed edges of the plates were thoroughly inspected: the defects detected were marked and the type and positioning of the defect was indicated.

The quality of the plates made from ingots poured by different methods is described by the data given in Table 2. The change in the method of pouring resulted in a halving of the percent of plates rejected on account of seams and, hence, the amount of plates rejected on account of metallurgical defects during the primary inspection decreased (see Table 2). Transverse cracks on the plates from ingots of both groups were on the section near the hot top.

It is also of interest to note the distribution of the seams on the cut-off edges of the plates (Table 3). The data given in Table 3 show that the increased rate of filling the hot top of the ingots is accompanied by a considerable reduction in the amount of ingots with defective edges.

The decrease in the defects of those plates which were obtained from ingots in which the hot top was filled at a higher rate may be explained by a more efficient removal of nonmetallic inclusions from the ingot.

On the basis of the results quoted above, the new, tested method of filling the hot top (at the same rate as the rate of filling the ingot) was recommended for use in the mass production of bottom-poured large ingots for steel plate.

Owing to the increased rate of filling the hot top, it is possible to improve the quality of ingots substantially with respect to seams, with an unchanged condition of the ingot surface. In addition, the length of time for pouring the steel from the 130-ton ladle is reduced by 8-10 minutes.

INTER-WORKS COURSE ON OPEN-HEARTH REPAIRS AND ON THE MAINTENANCE OF OPEN-HEARTH FURNACES

Engineers G. F. Germanidze and V. G. Pushkov

In July, 1958, the Technical Department of the Sverdlovsk National Economic Council, together with TsBTI*, arranged an Inter-Works Course at metallurgical establishments in the Urals on open-hearth repairs and the maintenance of the open-hearth furnaces.

The course was attended by leading steel melters and senior foremen from the iron and steel works of the Sverdlovsk National Economic Council as well as from the Chelyabinsk Tube-Rolling Works and the Kazakh Metallurgical Works.

The members of the course visited some large iron and steel works of the Sverdlovsk National Economic Council.

The object of the course was to reveal and evaluate the best methods of repairing the open-hearth furnace bottom, to give practical assistance to iron and steel works in mastering advanced methods and techniques and to plan concrete organizational and technical measures aimed at a further reduction in the shutdown time for repairs.

The members of the course have found that the methods of carrying out current repairs of the open-hearth furnace bottom and the extent to which mechanization is utilized in furnace repairs vary from works to works. It is seen from the table that the idling periods of the furnaces during repairs are different at different works and shops.

The steel melters at the Nizhne-Tagil Metallurgical Combine achieved the lowest idling periods. Owing to the strict observance of the technology of steelmaking, an efficiently organized maintenance of the bottom, full mechanization, and the application of advanced methods of furnace bottom repairs, the idling periods on bottom repairs in 1958 were reduced by 42% at the No. 1 open-hearth shop and by 100% at the No. 2 open-hearth shop. A. S. Pozdnyakov, senior foreman of the first group of furnaces of the No. 1 shop reduced the idling periods to 0.64%; I. A. Shimin, senior foreman of the first group of furnaces of the No. 2 shop taking part in the Inter-Works Course, reduced the idling periods at 140-ton furnaces to 0.86%. When, in 1957, the Serov Combine changed to the two-layer bottom-sintering of furnaces, the idling periods decreased from 5.4% in 1955 to 4.36%, and after the adoption of one-layer sintering, in March, 1958, they decreased to 2.8%. The idling periods at the Alapaev Combine were reduced by 42%.

At the same time, at the Kushva and the Verkh-Isetsk Works, in spite of a noticeable reduction, the idling periods are still much too high. At one of the furnaces of the Kushva Works, the idling periods on bottom repairs constitute 1.6%, i.e., are of the same order as at the most advanced works. Owing, however, to long idling periods at other furnaces, the average figure for the shop was high (3.53%). The decisive factor in the reduction of the idling periods of furnaces during bottom repairs is a knowledge of and a conscientious attitude toward the furnace maintenance on the part of the steel melters operating the furnace.

All the furnaces at those works are automated and equipped with modern instrumentation.

The NTMC produces mainly structural carbon steel. Low-carbon steel, which requires a high temperature during melting and pouring, constitutes a substantial fraction of the total output. In its basic furnaces the Serov Combine makes about 50% alloy steel and about 10% semi-product for the acid furnace. The processing of the semi-product has a harmful effect on the durability of the bottom for the low-mobile, high-basicity slags which form in the course of the process and settle on the bottom during the tapping of the steel. The Seversk Works specializes in the production of low-carbon rimmed steel for tin plate, and the Verkh-Isetsk Works specializes in electrotechnical steel of 0.08% carbon and 0.012-0.018% sulfur content.

We give below a description of the method of bottom repairs as practiced at various iron and steel works[1].

A. K. Serov Metallurgical Combine. After the heat has been tapped, the false sills are removed and movable platforms, from which the bottom is inspected and cleaned, are placed near the charging doors. Very frequently, ridges remain on the bottom since in the majority of the heats thick high-basicity lime slags are made. The ridges are eroded by means of sand or scale. At the same time, the banks and the back wall of the furnace are fettled. The bottom is cleaned by means of compressed air (3.5-4.0 atm) fed through 3 pipes, each 1 inch in diameter, from the general air ring mains. As a rule, the cleaning operation is done in three steps with 5-10 min reheating for the accumulation of any spattered remainders of steel and slag. An inadequate air pressure prolongs the cleaning operations and, consequently, the total time of repairs (cleaning the bottom takes an average of 50-60 min).

For repairs carried out by the members of the course, air at 4.5 atm pressure was provided. Therefore, it was possible to reduce the time of bottom cleaning to 15-20 min. After it is cleaned, the bottom is heated up. The magnesite powder (a layer of up to 150 mm thick) is thrown by means of a fettling machine. The front wall is fettled by hand. 8.5-10.0 tons of powder is used for one operation. Scale is used for slagging the bottom. The front and back walls are slagged twice. Scale is thrown onto the back wall and transverse banks by means of the fettling machine

*Central Office of Technical Information

[1]A description of the bottom repair practice at the NTMC is contained in M. L. Lapin's article, this issue p. 60.

and onto the bottom – by means of a charging box with a mesh lid, and the front wall is slagged by hand. Recently, the practice of throwing the scale onto the bottom by means of the fettling machine was started.

The taphole is restored as follows.

After the hole is cleaned and freed of the rammed material consisting of 50% magnesite powder, 40% chromite ore and 10% fire clay, the base of the hole is repaired. A short tube of an appropriate diameter is then inserted into the hole, and magnesite powder is thrown onto the tube. The space between the tube walls and the wall of the taphole is filled with the plugging material. After the slag is run off, the short tube is replaced by another tube of a diameter and length corresponding to the dimensions of the taphole which is then finally filled.

The Seversk Metallurgical Works. The repairs of the bottom are planned within the monthly schedule after every ten days of operation. The furnaces are stopped for repairs strictly according to the fixed schedule. At present, the durability of the furnace bottoms at the Works is fairly high and, therefore, when the furnace is stopped for repairs, the bottom is not, as a rule, extensively eroded. The repairs of an even slightly eroded bottom result in an over-all increase in idling periods, an excessive consumption of magnesite powder and the formation of the overgrowth on the bottom.

The bottom is cleaned by means of compressed air with the use of one pipe only because of the low air pressure (3.5-4.0 atm). The bottom is not heated before the magnesite powder is thrown. Thw powder is emptied out of the charging boxes by means of the charging machine onto the bottom near the front wall and then is distributed over the bottom by means of compressed air. The fettling machine available at the plant and made by the Debaltsevo Machine-Building Works has a low-capacity bin (2.7 m^3) and, therefore, it is not possible to mechanize the fettling process fully. Usually only one layer, up to 150 mm thick, is sintered onto the furnace bottom. The scale used for slagging the bottom constitutes 25% of the total amount of powder used in repairs. The scale is thrown by hand.

During the repairs, supervised by the senior foreman of the Kazakh Metallurgical Works, F. I. Vashchenko, who took part in the course, a chraging box with a grid was employed in the work on the bottom of one furnace. Since only one such charging box was employed, no noticeable gain in time was achieved. Nevertheless, when there is an adequate number of charging boxes equipped with grid lids, and when the operators of the charging crane or machines are familiar with the work, this method can be usefully employed at those plants where for any reason the fettling machine cannot be used for throwing the magnesite powder.

A mixture consisting of 20% magnesite powder and 80% ground chromite ore is used for sealing the taphole. 10-15% of fireclay is added to the mixture. The taphole is dressed from both sides with moist chromite ore and then with magnesite powder. Then, a tube made of 0.35-0.8 mm thick iron plate and filled with moist ground chromite powder is fitted into the hole. When the heat is tapped the tube burns through.

Verkh-Isetsk Metallurgical Works. Layer-by-layer sintering of the bottom is still practiced at this Works. Usually, the repairs are carried out as follows:

Idling Periods of the Open-hearth Furnace during the Repair of the Furnace Bottom, in % of the Calendar Time of Operation

Establishment	1957			6 months of 1958		
	the best furnace	the worst furnace	average for the shop	the best furnace	the worst furnace	average for the shop
Nizhne-Tagil Combine						
Shop No. 1	1.0	2.0	1.4	0.6	1.2	0.8
Shop No. 2	1.7	2.3	2.0	0.71	1.17	0.99
Serov Combine	3.71	5.66	4.36	2.64	3.26	2.8
Alapaev Combine	2.61	2.82	2.72	1.19	1.81	1.57
Seversk Works	2.47	3.07	2.77	1.73	2.65	2.03
Salda Works	2.07	2.48	2.28	2.71	3.04	2.55
Verkh-Isetsk Works	3.82	5.30	4.48	3.73	4.16	3.96
Kushva Works	4.26	5.1	4.78	1.6	3.9	3.53
Nizhne-Serginsk Works	2.1	2.9	2.6	2.3	2.65	2.48
Revda Works	2.33	2.47	2.4	2.66	2.70	2.68

After the slag is drained, about 200-300 kg of scale is spread on the surface of the bath to soften the "sediment" remaining on the bottom. The bottom is cleared from the metal pools with compressed air (4-5 atm), in two or three operations by means of two tubes 1¼ inches in diameter.

Magnesite powder is thrown by hand into the eroded holes and near the back wall. At the same time, the fuel rate is substantially reduced. Depressions of the bottoms and deep holes are filled in by two or three layers, the last layer being slagged with ground slag from the electric furnace. While the hot flame is turned on to heat the magnesite powder in the holes, the front and back wall of the furnace is fettled by means of the fettling machine. Magnesite powder is then spread onto the bottom and is heated, and then scale or slag is introduced. The powder and the slag are thrown by hand onto the bottom, the front wall and the bands, and this operation is the main determining factor in the duration of the repairs (7-8 hrs on the average).

The total quantity of the scale used is about 50-60% of the total quantity of the magnesite powder used in the repairs. After the slag is drained, the firing of the fuel oil is stopped and the furnace is cooled for 10-15 min.

During the bottom repairs, supervised by the foreman of the Alapaev Combine, Comrade Bedryk, the bottom was cleaned without the heating-up. The furnace was cooled down to such an extent that low spots were filled with solidified materials which were burnt out with the blast of compressed air. The furnace was not heated after the cleaning. Initially the powder was thrown onto the bottom

by hand but, later on, in view of the serious erosion of the furnace, the powder was delivered in charging boxes by means of a charging crane and then spread by means of compressed air. The slagging of the bottom was done by hand, and after the slagging the furnace was not cooled.

The Inter-Works Course made the following recommendations based on the study of the experience accumulated at various works regarding open-hearth bottom repairs.

1. A uniform wear of the sintered-in layer in the course of the furnace operation between repairs and a constant maintenance of the normal contour of the bath prevent the formation of a local accumulation of slag and metal pools, reduce the duration of repairs and, at the same time, improve the durability of the furnace bottom.

2. The bottom repairs should be planned in the weekly schedule, since, in the monthly schedule, it is not possible to ensure that the furnace will be stopped at the best moment with respect to bottom erosion. The repair schedule must be strictly adhered to.

3. The preparation of the bottom for cleaning should take as short a time as possible; this is achieved by a thorough maintenance of the bottom during operation and a planned preparation for repairs.

4. The bottom of the furnace should be cleaned by means of compressed air at not less than 5.0 atm pressure, and, where possible, with compressed oxygen at 6.0-9.0 atm pressure blown through two or three tubes simultaneously, the fuel input to the furnace being shut off or reduced to a minimum. For the blowing, it is economical to use tubes made of heat-resistant steel.

The cleaning of the bottom should be carried out in one operation in as short a time as possible and the damaged sintered layer of bottom should be removed as thoroughly as possible. The Course considers it uneconomic to operate the furnace with a hot flame when collecting the metal and slag which spattered on the bottom during the cleaning operations.

5. The operations on covering the bottom with the magnesite powder and scale should be fully mechanized.

6. Only one layer of the magnesite powder should be sintered on the furnace bottom; sintering 2 or 3 layers prolongs the repairs without increasing the durability of the bottom. The layer should be made up to 150-200 mm thick.

7. The layer should be heated (sintered) at the same rate of fuel firing as during the charging period. The time of heating should be not more than 1.5 hrs. With a longer heating, the durability of the bottom decreases.

8. The slagging of the bottom with the scale reduces the time required for repairs and, at the same time, increases the durability of the bottom. For slagging the sintered bottom one should use fine screened rolling-mill scale of not more than 2.0% SiO_2 content. Depending on the particle size of the magnesite powder, the quantity of scale used for slagging should amount to 25-50% by weight of the magnesite powder used in the repairs.

9. After the scale has been applied, one must not allow the accumulation of slag on the bottom since this reduces its durability.

10. For plugging the taphole, it is desirable to use a piece of tubing made of roofing sheet iron. For medium and large-capacity furnaces the Course considers it necessary to test heat-resistant concrete which could ensure a high durability of the taphole.

THE USE ON OXYGEN OF FURNACE-BOTTOM REPAIRS AND THE INCREASE IN THE DURABILITY OF THE BOTTOM

N. L. Lapin

The large-capacity open-hearth furnaces comprising the first group at the No. 1 shop of the Nizhne-Tagil Metallurgical Combine have hearths of 78 m^2 and 81.4 m^2. The magnesite brickwork of the bottom of all the furnaces is 650 mm thick and the sintered layer is 220 mm thick. The roofs are made of periclasospinelide brick and are 460 mm thick. The ports, the vertical channels, and the lining of the walls of the slag pockets are made of chrome-magnesite. The upper 7-12 courses of the gas and the air regenerators are laid with forsterite brick, and the lower with firebrick.

The furnaces are fired with a mixture of blast-furnace gas and coke-oven gas, the flame being carburetted with coal tar or anthracene oil introduced through the roofs of the gas slag pockets, during the melt-down and the finishing period of the heat.

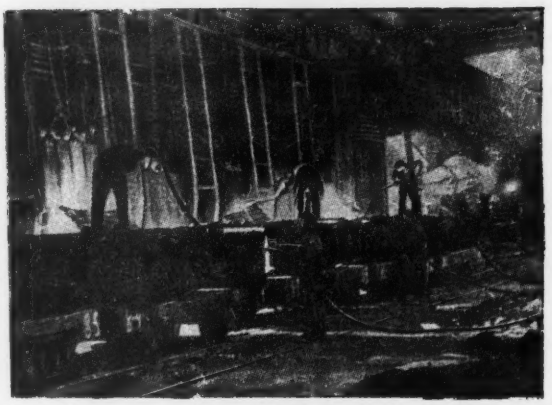


Fig. 1. Cleaning the bottoms with three tubes at the same time.

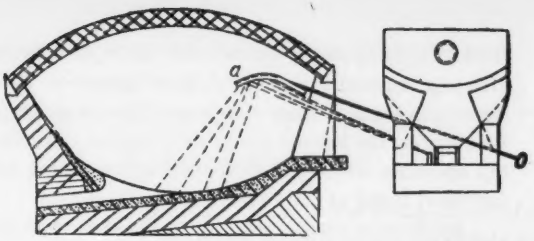


Fig. 2. The method of throwing magnesite powder onto the bottom by means of the fettling machine; a) deflecting spoon.

For the intensification of the combustion process, oxygen is supplied through four tubes (two for each port), 25 mm in diameter, mounted in water-cooled tuyeres and set at an angle of 8° to the horizontal at a height of 200 mm above the floor of the gas duct. In addition, two furnaces have equipment for introducing oxygen directly into the bath through the roof. The furnaces are equipped with modern measuring and recording instruments. The scrap-ore process is used and the charge contains up to 70% liquid pig iron.

Here are some operating statistics of the furnaces:

	Years			
	1955	1956	1957	1958
Idling periods for bottom repairs, %	3.4	2.7	1.2	0.8
Average duration of furnace repairs, hr-min	7-26	6-17	4-01	2-50
Bottom life, in number of heats	16.3	22.9	23.5	33.1

A reduction of idling periods for bottom repairs took place on account of shortening the time required for bottom repairs and extending the operating period between repairs. These results were achieved thanks to a change in the repair methods, improved maintenance of the furnaces, systematization of the operational technical and thermal regimes as well as the use of oxygen for cleaning the bottom.

As a rule, the bottom is inspected after every heat. Any remainders of slag and metal found on the bottom are throughly blown out, and the holes are filled with magnesite powder. Ridges and high spots are treated with scale. All these operations are carried out during the fettling of the furnace so that the duration of repairs is not protracted. As the bottom is eroded, the base of the taphole is lowered by blowing it with oxygen. Owing to a careful maintenance of the furnace and the observance of the operating procedure and the thermal regime, the bottoms are eroded uniformly.

Prior to the bottom repairs, rimmed steel is usually made. Special care is taken to prepare all the necessary materials and tools for the repair operation in good time.

As is known, the time taken for bottom repairs is counted from the beginning of tapping the heat. When the level of metal and slag falls below the main sills, the false sills are removed and molds are brought to the furnace. After the heat has been tapped, the taphole is blown with oxygen, and the base of the taphole is lowered so that all the residue of the metal and slag is drained when the pools which collect on the bottom are blown out. Hoses with tubes are connected to the outlets of the oxygen main extended to the working platform. During the period when the bottom is being prepared for the repairs, the thermal regime maintained in the furnace is the same as during the finishing period of the heat. The whole preparatory period, including the tapping of the heat, lasts for 20-25 min.

Time of Sintering and Slagging the Bottom, and its Service Life

Period of operation	Method of sintering	Time of sintering and slagging, hr-min	Life of bottoms, heats
1st quarter of 1957	Two layers	2-29	22.1
2nd " "	"	2-58	20.3
3rd " "	"	2-57	21.5
4th " "	One layer	1-41	31.9
1st " 1958	"	1-36	33.1
2nd " "	"	1-43	30.0

Oxygen for bottom cleaning is fed simultaneously through three tubes (Fig. 1), each 55 mm in diameter and 8 m long, made of heat-resistant steel. During the blowing-out of metal and slag residue, the tubes are supported in inspection holes in the charging doors. The high pressure of the oxygen (7-8 atm at the tube outlet) during the bottom cleaning makes it possible not only to blow out the metal and slag from the depressions but also to remove the worn out iron-oxide-soaked surface layer of the bottom. Part of the blown-out metal burns through under the action of the oxygen, as indicated by the appearance of brown fumes in the furnace during furnace cleaning.

The bottom-cleaning operation is carried out by the senior foreman, the steel melter of the furnace, and the steel melter or the first assistant of the neighboring furnace. The metal and slag from the depressions near the end doors are blown out through the steel taphole, and form the depressions near the middle window – through the opening. During the blowing-out operation the tubes are positioned appropriately with respect to the pool surface so that the spattering of metal and slag is reduced to a minimum.

During the cleaning of the bottom, the fuel is usually shut off. The temperature of the roof then falls to from 1600-1650 to 1350-1400°C. As a rule, the metal and slag from the depressions are blown out in one operation lasting 25-30 min.

The adoption of heat-resistant tubes facilitates and shortens the cleaning operation considerably since these

tubes are almost completely resistant to burning and remain straight. When compressed air was used, the cleaning of the bottom took 1.5-2 hrs. The use of oxygen and heat-resistant tubes reduced this operation considerably.

For sintering-in new layers, pure magnesite powder, grade "Ekstra", is used. The powder is thrown onto the bottom by means of the fettling machine with the use of a special deflecting spoon, in a definite sequence, viz., going from the first door to the fifth or vice versa (Fig. 2). The thickness of the layer sintered-in during the repairs investigated varied from 120 to 200 mm. After the new layer has been spread, the contour of the furnace is accurately adjusted. Usually, 8 to 12 tons of magnesite powder are used for sintering the bottom.

When the powder layer is built up, the rate of the heat input to the furnace is maintained at 12-15 million kcal/hr. The time of powder-throwing amounts to 25-30 min. During the sintering of the layer the rate of heat input is increased to 30-32 million kcal/hr. At the beginning of the sintering operation, the front-wall columns are dressed with a mixture consisting of 85-90% fine magnesite powder and 10-15% fireclay mixed with water. If ground chromite powder is available, the mixture for column dressing is made up of chromite powder (30%), magnesite powder (55%), and fireclay (15%).

The layer is heated for 50-60 min. The temperature of the roof toward the end of the heating operation rises to 1650-1700°C.

For slagging the sintered layers in a furnace repair operation, the scale (56-58% FeO, 40-41% Fe_2O_3 and 0.5-0.7% P_2O_5) obtained from the rolling mills at the Combine is used. The amount of the scale used is 50-60% of the amount of magnesite powder.

During the last heat before the repairs the scale is charged into special charging boxes tightly covered with lids which have holes 50 mm in diameter. These charging boxes are operated by means of the charging machine to cover the furance bottom, through each charging door with a uniform layer of the scale. The sintered layer is soaked with the scale for 20-30 min until pools begin to form at the taphole. Usually 2 or 3 charging boxes (5-6 tons) of scale are used up for slagging. During the slagging operation the fuel rate is not reduced. After the slag which has formed on the bottom is run off, the furnace is ready for charging.

As is well known, the wear resistance of the sintered magnesite layer depends on various factors. How long a time it takes to prepare the furnace for the cleaning operation depends on the condition of the steel taphole, the condition of the bottom, and the organization of the work to be done on the taphole after the heat has been tapped. Preparing the bottom quickly for the cleaning operation and maintaining a fairly high rate of fuel firing prevent the residue of the slag and metal from solidifying on the bottom and ensure their more efficient removal during the cleaning operation, and thus the repairs become more effective. The use of oxygen for cleaning the bottom results in a marked reduction in this operation which previously (when compressed air was used) lasted at least 1.5-2 hr.

We have to assume that during the short shut-offs of the fuel in the course of bottom cleaning with oxygen the roof cools to a very small depth, since in 5-10 minutes from the time when the fuel gas had been switched on again after the cleaning operation, the temperature of the roof rose to 1650-1700°C. There was no noticeable spalling of the roof during the initial chargings after the repairs. The life of the roofs of the furnaces under investigation constituted 460 heats in 1957 and the first half of 1958; the average life of the roofs at the plant in 1956 was 332 heats.

The experience of the Magnitogorsk Metallurgical Combine shows that the reduction in the time of bottom cleaning and better efficiency of cleaning increase the life of the bottom between consecutive repairs. The most complete cleaning of the bottom, including the removal of the worn-out surface layer, is attained in 45-55 min and it ensures the longest life of the bottom after the repairs. If the cleaning operation takes longer, the life of the repaired bottom decreases.

The operational experience of iron and steel works confirms the expediency of sintering one layer only. Under the conditions which prevail at the NTMC, when only one layer, 150-200 mm thick was sintered-in, the time of repairs was decreased and the life of the repaired furnace increased (see Table).

Hence, we must accept the fact that the bottom-repair operation may be completed without waiting until the whole new layer forms into a continuous material. Of course, for a given thickness and with relatively short heating and slagging periods the diffusion of iron oxides into the periclase grains proceeds at full speed only on the surface of the layer. The skin which forms prevents the metal from penetrating deep into the layer. The final formation of the continuous structure of the sintered-in layer is attained during the first heats after the repair.

Operating experience on the thick layer was made use of during the sintering-in of the new bottom of a 140-ton furnace after a major overhaul. The bottom of this furnace was sintered-in in four layers in 36 hr 20 minutes; the over-all thickness of three layers was 60-65 mm and the fourth layer was 150 mm thick.

In the first two heats of a normal weight, liquid pig iron was used. The heats lasted 6 hr and 6 hr 15 min, respectively. The new sintered-in bottom withstood 36 heats without repairs.

PRACTICES OF THE KAZAKH METALLURGISTS

N. Ishmukhamedov

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The various existing methods of sintering-in the furnace bottom may be divided into two main groups:

1. Sintering the bottom with the use of high-magnesium charge containing 70-75% magnesium oxide in the sintered-in layer. Each layer, 20-25 mm thick, is heated for a long time in order to attain the transformation of the periclase grains.

2. Sintering the bottom with the use of a charge containing 15-17% fluxing components (slag or scale, or both in various ratios). A thick layer (40-60 mm) of the powder is placed on the bottom and is heated for a short time. The final transformations in the mineral constitution of the bottom take place during the first heats after the bottom repairs.

The experience of the Kuznetsk Metallurgical Combine and the Kazakh Metallurgical Works shows that the second method of sintering the bottom is more advanced. With this method, the time of the repairs is reduced owing to a reduction in the number of the layers and the time of heating. The repair operation, when carried out by the second method, lasts for 2-4 hr depending on the condition of the bottom.

Below, we give figures on the idling periods due to bottom repairs of open hearth furnaces at Kazakh Metallurgical Works, in % of nominal time of operation.

Years:	1950	1951	1952	1953	1954	1955	1956	1957
Idling periods (average for plant)	3.59	2.96	2.36	2.07	2.1	2.89 *	2.30	2.0

Until 1949, the Kazakh Works used the widely accepted method of sintering-in the bottom in thin layers and heating each layer for a long time so that a uniform structure would form. With this method long idling periods during repairs were unavoidable.

In 1949, experiments on finding better methods were carried out and as a result, the rapid and the layer-by-layer speeded-up methods were developed.

The new methods of furnace repair are based on allowing an incomplete sintering of the magnesite powder grains in the restored layer and on some reduction in the content of magnesium oxide in the final sintered layer (to 60-65%). Such a layer of an adequate heat resistance "ripens" in the course of the first heats after the repairs and acquires a very uniform and monolithic structure. The thickness of the layer was increased to 40-100 mm (compared with 20-25 mm previously) and the time of heating the layer was reduced to 40-90 min (compared with 3-6 hr previously).

A rapid sintering of the thick layers is attained due to a substantial content of fluxes (up to 15-17%).

The rapid method is used for repairing holes not more than 200 mm deep and of 1 m^2 area. Without the furnace being allowed to cool, the hole is quickly cleared of the residue of slag and metal by means of compressed air, and then unscreened magnesite powder is spread in one operation on the furnace bottom. This thick layer is heated for 30-60 min until glittering spots appear due to the slag which flows down from the elevated points of the sintered layer.

The sintered place is then treated with the scale or slag and the furnace is made ready for charging.

Naturally, a complete transformation of the periclase grains does not take place in the newly made layer heated for only a short time as it does during repairs involving a prolonged heating of thin layers.

With this rapid method, the total time of repairing the holes amounts to 1.5-2 hr.

The service life of the bottom after a rapid repair is 22-27 heats on the average.

The layer-by-layer speeded-up method of bottom repairs is used when the bottom is uniformly eroded or the holes are more than 1 m^2 in area and more than 150 mm deep. The magnesite powder is then applied in several layers, each 40-60 mm thick and each layer is heated for 60-90 min. The life of the bottom when it is repaired by this method amounts to 24-27 heats on the average. As a rule, the repair operation takes no more than 4-5 hours which means approximately 4-7 min idling time per heat.

It should be noted that the division of repairs into rapid repairs and layer-by-layer speeded-up repairs is an arbitrary one.

Properties of the materials used for bottom repairs. At this Works, metallurgical magnesite powder is used for bottom repairs. It is well known that to speed up the sintering process of the powder, special fluxing additions must be introduced.

Until May, 1952, open-hearth furnace slag was added as a fluxing agent to the magnesite powder. Open-hearth slag, however, has no constant chemical composition, it is very frequently of a low basicity, and has a high

*The deterioration in the operation of the sintered bottom in 1955 was due to the introduction of the magnesite powder from China.

silicon content (up to 25%). The varying chemical composition makes it difficult to maintain the present regime of repair operation.

Therefore, scale or a mixture of scale and slag began to be used as the fluxing additive. Tests showed that when scale is used in an amount calculated on the basis of 60-65% magnesium oxide content in the layer, a satisfactory durability of the sintered layers is attained.

Other compositions of fluxing additions were also tried out. In May, 1957, the steel melters of the Works began to use ilmenite concentrate.

As the addition to the magnesite powder, the ilmenite concentrate has several advantages over the open-hearth slag and the rolling-mill scale:

a) a constant chemical composition, the main components being ferrous oxide and titanium oxide (total 90%);

b) a negligible amount of harmful or accidental inclusions, in particular silicon (3% maximum).

However, the sintering effect of titanium oxide was noted earlier mainly when fine-grained (below 2 mm) magnesite material was used. The question of the effect of titanium oxides on the sintering process of coarse-grained material and on its durability under the operating conditions in open-hearth furnaces has not yet been fully investigated. It may be assumed that the replacement of a part of iron oxides by titanium oxide should not impair the properties of the sintered layer. The reasons for this assumption are as follows:

In the course of furnace operation most of the ferric iron is transformed into ferrous iron. The change in the degree of oxidation of iron and the decomposition of the compounds of ferric iron by other chemical components of the sintered layer are the main causes of normal wear of the layer. By substituting ferric oxide in the components of the sintered layer, the titanium oxides, being more difficult to reduce will, on the contrary, enhance the durability of the titanium-containing sintered layers.

Recently in connection with the use of ilmenite concentrate, the layer-by-layer method has been adandoned. Now, the bottom is covered with a layer of the required thickness depending on the character of the wear or the damage of the sintered bottom. In this way, it is possible to reduce the time of repairs from 4 hr 5 min-4 hr 34 min (average for 5 months of 1957) to 3 hr-3 hr 40 min (average for 4 months of 1958).

During the time since the ilmenite concentrate was first used, various ratios of the concentrate to the scale content in the mixture have been tried.

Since December, 1957, a mixture consisting of 88-89% magnesite powder, 6-7% concentrate, and 4-5% scale has been used for bottom repairs. The life of the bottom is 41 heats.

The use of the ilmenite concentrate for the sintered layer of the bottom made it possible to reduce the idling periods of the furnaces due to bottom repairs from 2.31% in 1956 to 2.0% in 1957, i.e., by 0.3% of the nominal time of operation.

The main drawback in the use of titanium-containing mixtures is the high cost of the ilmenite concentrate and the extra transportation of the mixture. Nevertheless, it has been shown that the sintering mixtures of various compositions, as used at the works, and containing up to 15-17% fluxing additions, are suitable for the repair of bottoms by the method of "thick layers".

NEW ROLLING MILLS

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"In 1959-1965, the construction of large-capacity, mechanized and automated metallurgical plants provided with modern equipment will be carried out. It is hoped to build highly productive section and tube mills..., which will ensure the continuity of the production process..., the mechanization and automation of production operations..."

(From N. S. Khrushchev's speech at the Twenty-first Congress of the Communist Party of the Soviet Union)

In 1965, the output of rolled products of ferrous metals should be 65-70 million tons, i.e., it should increase by 52-64% compared with 1958. A large expansion is taking place in output of rolled products of nonferrous metals, in particular aluminum, magnesium, and copper alloys as well as titanium.

The output of steel plate, tubes, bent sections, reinforcing steel, etc., will increase substantially.

All this requires an improvement of the old and the establishment of new rolling mills and techniques.

Plate mills. For the next 10-15 years, the main stress will be laid on the construction of wide-strip (plate) rolling mills. Calculations show that a continuous mill for rolling 1.5 to 8-10 mm thick steel plate is the most economic with respect to capital expenditure and operating cost per ton of product.

As the optimum mill of that type, one should consider the mill having rolls of 1700-2100 mm barrel length since such a mill produces steel plate which is the most in demand; the output of the mill is over 250 tons per hour or 3.5 million tons per year; the weight of the mill equipment is about 18,000 tons, the slabs rolled weigh up to 15.5 tons and the speed of rolling is up 15 m/sec. These basic characteristics of the continuous mill designed in the USSR are better than those of similar mills built earlier in the USSR or abroad.

The typical modern five-stand mill for the cold rolling of tin plate and other thin-sheet products in the mill, designed in the USSR, for rolling 0.18-0.60 mm thick strip from the initial coiled material 1.8-4 mm thick and up to 1000 mm wide. The mill will produce coils up to 15 tons in weight. The maximum speed of rolling will be 35 m/sec; the total capacity of the main drive motors will be 27,000 hp. A machine operating at a speed of 5 m/sec for the electrolytic removal of grease, as well as furnaces for the continuous annealing of coiled tinplate, will be installed behind the mill.

With the object of improving the mechanical properties of tinplate, a two-stand mill operating at a speed of up to 32 m/sec has been designed. The plant will include electrolytic-pickling machines operating at a speed of up to 7.5 m/sec and machines for the continuous galvanizing of strip at a speed of up to 15 m/sec. The annual output of such a mill depends to a great extent on the type of product and constitutes about 700,000 tons.

In addition to continuous sheet-rolling mills, there are reversible mills under construction, with coilers or roller tables in the furnaces, and they will be put into operation in the next few years. On the roughing stands of a mill of that type the billet is rolled down to 20-30 mm thickness and then to the final thickness of 1.5 mm on the finishing stand.

Mills with the coilers in the furnaces permit a more flexible control of the temperature regime of rolling. This is especially important when steels which are difficult to deform are rolled as well as steels with special properties requiring a narrow temperature range during rolling. Therefore these mills are designated for the production of stainless and heat-resistant steels and special alloys.

In recent times, designers have been paying considerable attention to the so-called planetary rolling mill in which over 20 working rolls (planetary rolls) are arranged around one backing-up roll. In this way, the weight of the mill is decreased and that is its main advantage. On one stand of such a mill the strip is reduced by 95-98% in one pass. The drawback of the planet mill is a low speed of exit of the strip and, consequently, a lower output as compared with ordinary hot-rolling strip mills.

The planetary mills to be built in the USSR will be slightly different from those which are being built abroad. In particular, the rolls of the mill are driven not only by the backing-up rolls but also by means of the separator of the working rolls and so the design and the operating capabilities of the mill are improved. It is envisaged to combine such mills into one unit with the machine for the continuous casting of steel.

Tube mills. It may be assumed that in the next few years the most economic mill for the production of large-diameter welded tubes will be the mill which embodies the formation of the skelp into the tube in presses and subsequent arc welding or welding with electric heating of the edges.

For making thin-walled large-diameter tubes, spiral-welding mills (Fig. 1) which make it possible to produce tubes with the ratio of the tube diameter to wall thickness of more than 100 have been built in the USSR. The mill operates on the principle of the continuous process (thanks to the butt-welding of tubes), so that the process can be fully mechanized and automated. For making thin-walled small-diameter tubes, continuous mills of 7 m/sec maximum exit speed of the tube will be built, this speed being higher than at mills built earlier in the USSR and abroad.

The second guiding principle accepted in the USSR in the production of welded tubes is the combination of the planet strip mill with the reducing mill (Fig. 2) which has a welding speed of 2 m/sec and an exit speed of the finished tube of 12 m/sec.

The output of such a mill is 250,000 tons per year.

New branches of industry (jet engines, gas turbines, etc.) require various sections, plates, and tubes of heat-resistant alloys, titanium, and other special metals and alloys. There is a demand for large quantities of seamless thin-walled and special shape tubes, up to 100 mm in diameter, mainly of heat-resistant and stainless steels.

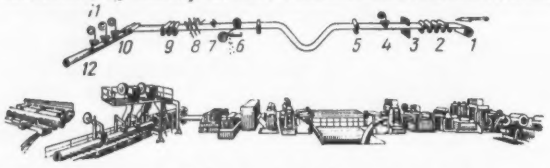

Fig. 1. Diagram of the mill which operates at the Il'ich Works for spiral welding of tubes of up to 650 mm diameter: 1) uncoiled skelp; 2) straightening of the skelp; 3) trimming the ends; 4) welding the skelp; 5) formation of the loop; 6) trimming the edges; 7) shot-blasting the edges; 8) machining the face with cutters; 9) delivering the skelp for shaping; 10) shaping the tube; 11) welding the spiral seam of the tube; 12) cutting the tube.

There are very promising prospects in the field of seamless tube production from hard metals and alloys in connection with the application for this purpose of planetary rolling which is useful for obtaining thin tube-walls. A mill of similar type (Fig. 3) is being successfully operated at the Moscow Tube Works. Some original planet mills for the hot rolling of seamless tubes of 80-160 mm diameter or even larger are being designed.

The mills designed in the USSR for the cold drawing of tubes (Fig. 4) compare favorably with the ordinary Rockrite machines, widely used in the USSR and abroad, as they are lighter (in particular the moving parts) and can be used for the production of seamless tubes with very thin walls (0.01 of the diameter or less) from hard metals and alloys.

An experimental continuous mill, consisting of 10 working stands with a separate drive for each stand, for the cold-drawing of tubes 25-40 mm in diameter has been developed in the USSR. The speed of the tube in the last stand is 3 m/sec.

Compared with the roll mills for the cold-drawing of tubes, the output of those mills is larger by a factor of 20-50.

Mills for rolling thin-wall sections. The design of a continuous mill consisting of 18 stands for rolling thin-wall section (angles, etc.) has been developed in the USSR. 12 m long, initial square billets are welded (after being heated) by means of a flying butt-welding machine into a continuous piece. The maximum exit speed of the section from the last stand of the mill is 12 m/sec; design output of the mill is 350 tons/hr. Compared with similar mills which have been built until now, the mill has the lowest weight of equipment per ton of rolled product.

Shaping and bending mills. The use of bent sections (made of strip) instead of hot-rolled sections in buildings and other structures ensures a reduction in steel consumption by 15-35%. In the next few years, in the USSR, it is planned to build plants of a productive capacity of 800,000 tons of bent sections per year and to expand this production considerably later on.

One of the shaping mills of the roller-bending unit, 1-4x400-1500 mm, designed in the USSR for making bent sections, will make sections from coiled strip 1600 mm wide, 1-4 mm thick and 10 tons in weight. The speed of shaping into section is 0.75-3 m/sec. The shaping mill consists of 20 open-type stands. The stands

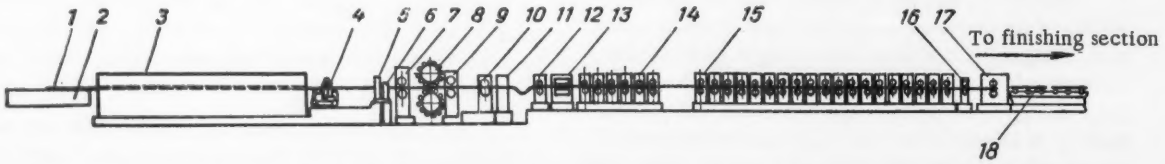

Fig. 2. Diagram of the tube welding mill combined with the planetary mill and the reducing mill: 1) slab; 2) feeding roller tables; 3) furnace; 4) flying welding machine; 5) burr remover; 6) hydraulic removal of scale; 7) entering stand; 8) planetary stand; 9) finishing stand; 10) disc shears; 11) edge trimmer, 12) entering rolls; 13) induction furnace; 14) welding machine; 15) reducing mill; 16) pulling rolls; 17) flying shears; 18) delivery roller tables.

are driven in groups by two motors of 280 kw, and 700-1400 rpm.

Mills for the production of very thin strip. Side by side with the extensive expansion in the production of cold-rolled, coiled, very wide steel strip, a considerable demand has been felt in recent years for thin (0.2-0.001 mm) strip.

Very modern, multiroll mills of high capacity, for the production of precision-rolled very thin strip from steel and special alloys, should be constructed in the USSR within the next years.

These mills include:

1. Twenty-roll mills (Fig. 5) for rolling stainless steel strip 0.1 mm thick and 1000 mm (or more) wide. The mill will use steel strip coils up to 15 tons in weight and will roll it at a speed of 8-10 m/sec. The annual output of the mill will be 125,000 tons.

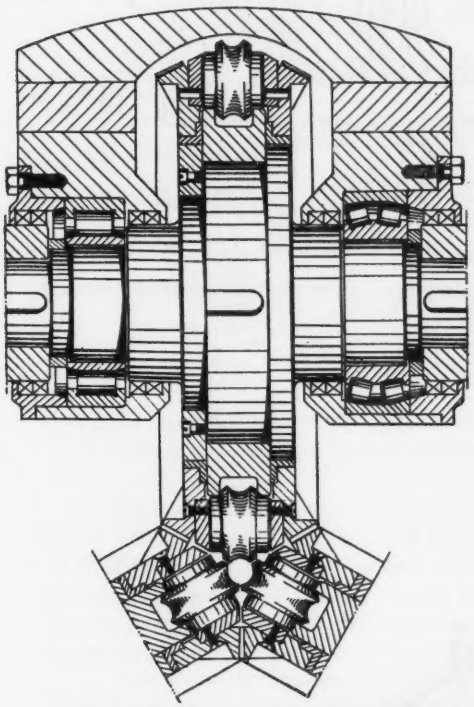

Fig. 3. Planetary mill for the cold rolling of tubes.

2. Twenty-role mills for rolling strip 0.02 mm thick and 400 mm wide from alloys which are difficult to work and from high-carbon steel.

3. Twenty-roll mills for rolling strip 0.001 mm thick and 30-50 mm wide from alloys with special physical properties.

To ensure the required accuracy the main operations on the inspection and control of strip thickness, etc., are to be automated.

In addition to a substantial economy in the weight of the equipment (up to 30-40% as compared with four-high reducing mills), the multiroll mills ensure a high productivity because the number of intermediate annealing operations during strip manufacture is reduced.

It is planned that in the course of the next few years hard-alloy rolls for the multiroll and other mills will be introduced and this will result in a longer life of rolls and a reduction in the number of dressings.

Mills for rolling periodic circular sections and other solids of revolution. It is possible and economic to use the rolling process for the production of very diverse types of articles, similar in shape and size to various finished parts. In the USSR, the following mills have been developed and should be extensively introduced in the next few years: a) for rolling mill balls and mill rods for cement grinding mills (Fig. 6); b) for rolling various shaped bushes (of the type of the hub for the rear wheel of a bicycle); c) for rolling stepped shafts, railroad axles, spindles for textile machines and other tubes or solids of revolution of a regular longitudinal cross section (Fig. 8). These mills are very economic owing to their high output and the saving in metal.

In the USSR, automatic lines for rolling and dressing standard machine parts (axles, bushes and other solids of revolution) will be constructed within the next few years. One can judge the advantages and the economic effectiveness of the new rolling processes from the example of the mill, designed in the USSR, for rolling railroad axles. One such mill with a capacity of 400,000 railroad axles replaces 10 hammers or 7 presses. At the same time, whereas the mill occupies an area of 6,700 m^2, the above number of hammers and presses would require 15,000 and 20,000 m^2 respectively. Steel consumption per one axle is reduced by approximately 20%.

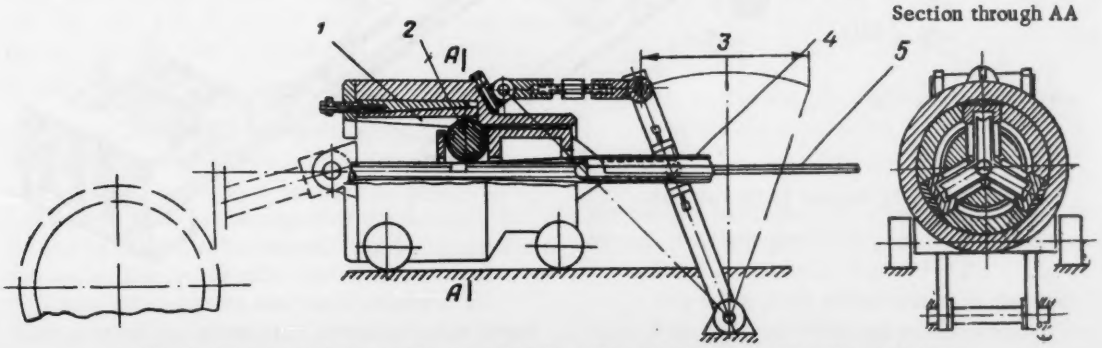

Fig. 4. Diagram of the working stand of the roller mill for the cold rolling of tubes: 1) gauge bar; 2) roll; 3) movement of the working stand; 4) tubes; 5) mandrel.

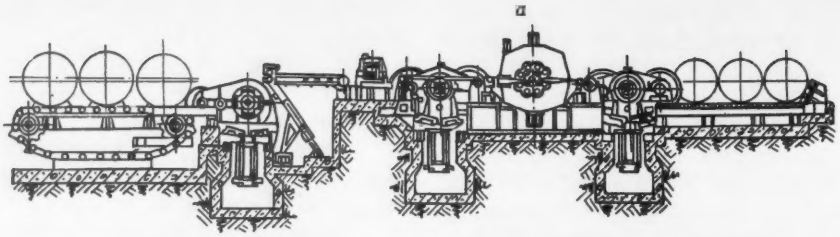

Fig. 5. Twenty-roll mill for rolling steel strip: a) working stand.

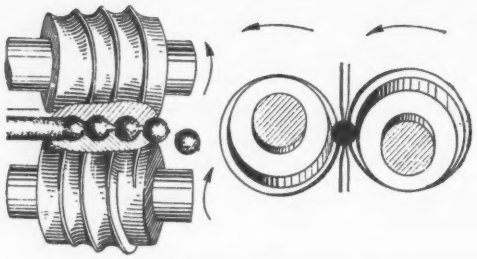

Fig. 6. Rolling the steel balls.

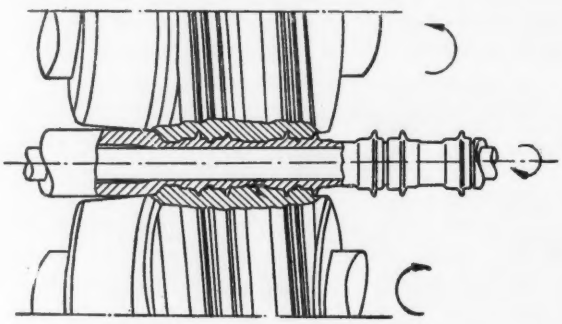

Fig. 7. Rolling the hubs of the rear wheel of a bicycle.

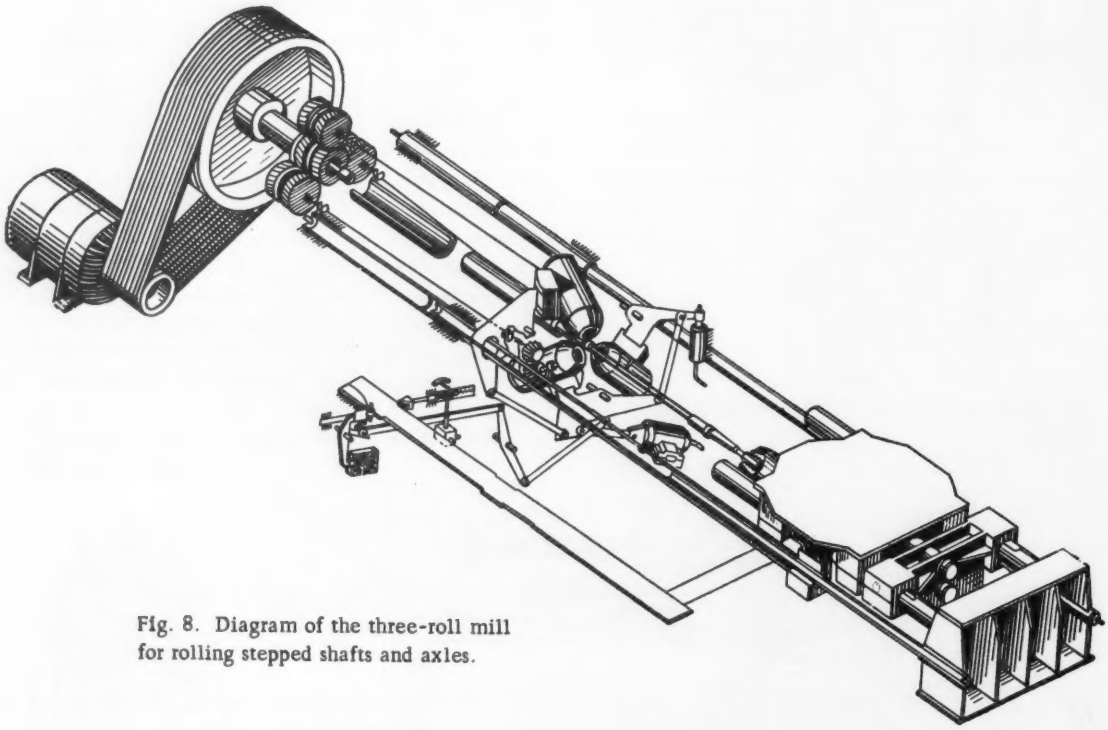

Fig. 8. Diagram of the three-roll mill for rolling stepped shafts and axles.

MODERNIZATION OF THE ROUGHING TRAIN OF THE LIGHT-SECTION MILL

L. M. Kochetov

Senior Roll Designer of the Salda Metallurgical Works

The roughing train of the mill consists of three stands: one three-high and two reversible two-high stands. The mill produces a wide selection of sections from square billets 80 × 80 mm.

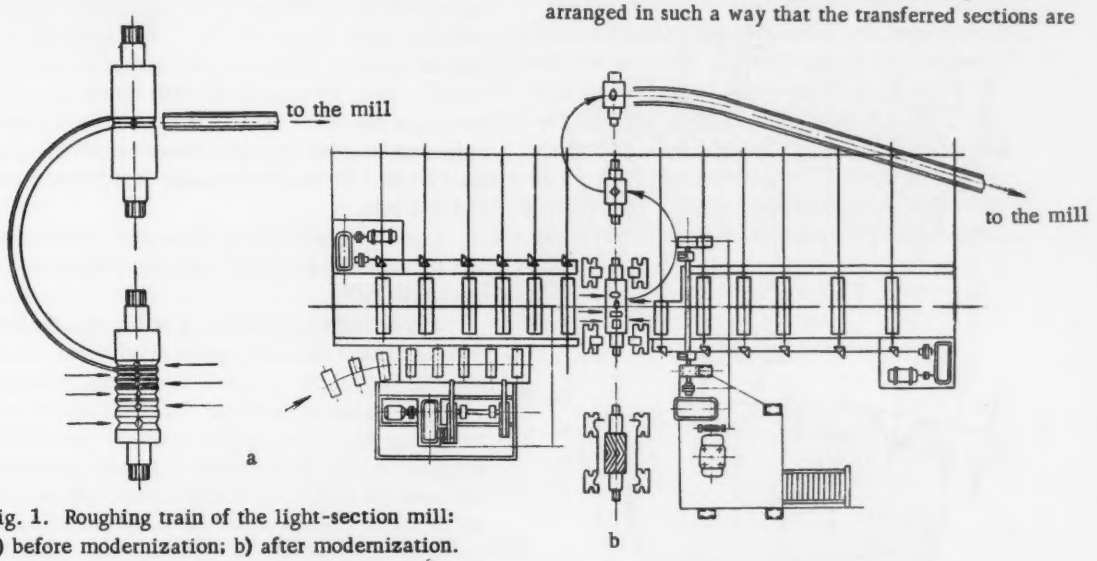

Fig. 1. Roughing train of the light-section mill: a) before modernization; b) after modernization.

The earlier method of rolling involved seven passes in the roughing train; six out of the seven passes in the first stand and one in the second, the third stand remaining unused. With this method, the time for rolling the piece in the roughing train amounted to 20 sec; the output of the mill was rather limited.

After the modernization of the roughing train, all three stands were utilized. Roller tables and manipulators were installed at the front end of the stand, and a lifting table at the rear end. The two other stands were equipped with repeaters. As a result, the time of rolling the piece in one line only fell to 13.4 sec, i.e., decreased by a factor of 1.5.

To carry out this improvement, it was necessary to alter the arrangement of the roll passes from diamond-square-hexagon-square-oval, to the rectangular system with the use of the hexagon-square-oval arrangement. The change of the pass arrangement was necessary for the mechanization of the process, i.e., the installation of the manipulators at the roller tables, the installation of the lifting table, and the automatic transfer of the rolled piece in two consecutive stands by means of the repeaters. At the same time, the passes were so designed that a reliable entry of the piece by means of the two consecutive repeaters was ensured. In the ordinary schemes, the problem is solved by transferring the oval and the square sections and simultaneously turning them through 90°. Such a transfer, however, does not always ensure a smooth operation. In the present case, the passes were arranged in such a way that the transferred sections are

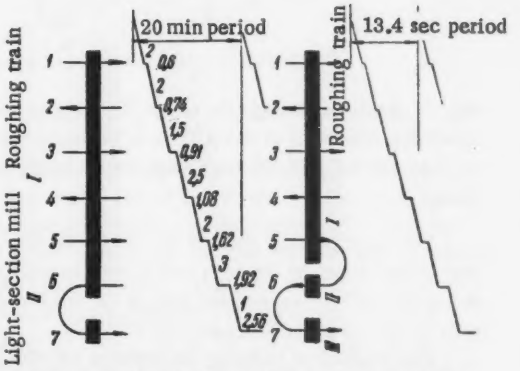

Fig. 2. Chart of the roughing train operation with one and two transfer: I-III) stands; 1-7) passes.

the hexagon (on edge, without being turned) and the square. This arrangement of passes ensured a reliable operation of the repeaters (Figs. 1 and 2).

As a result of the modernization of the roughing train of the mill, the operating personnel was reduced by nine men and the output of the mill was increased by 15%.

RAGGING THE ROLLS OF ROUGHING MILLS

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*Scientific worker of the Ukrainian Institute of Metals

**Senior foreman of the blooming mill at the Alchevsk Metallurgical Works

At the Il'ich Works, the strengthening of the working surface of the rolls is achieved by rolling them with a smooth roller. According to the Works' data, the service life of the rolls increased by more than 50%. But the disadvantage of this method is the smooth surface of the rolls, and hence, unfavorable conditions for gripping the rolled piece.

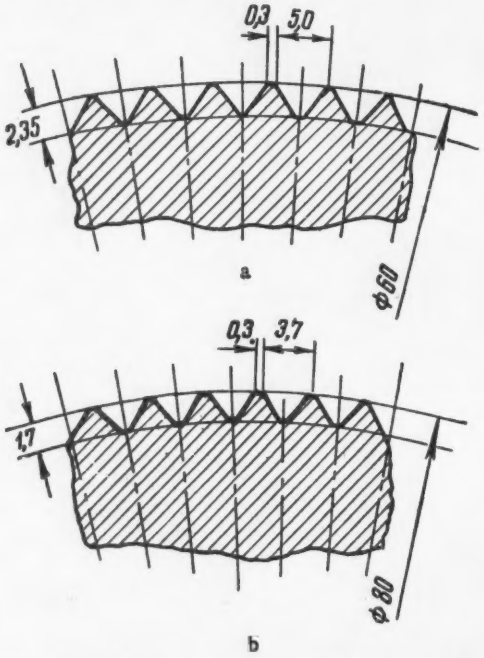

Fig. 1. Sections through the rollers for ragging the blooming-mill rolls at the Alchevsk Works; a) roller with pyramidal projections; b) roller with toothed surface.

The most rational method for improving the gripping of the piece by the rolls and simultaneously strengthening the surface layer of the rolls is the ragging of the rolls by means of a checkered roller.[1]

This method of treating the working surface is applied at the Kirov, Dzerzhinskii, "Azovstal'", and Alchevsk Works.

Two types of rollers were used for ragging the rolls at the Alchevsk Metallurgical Works: one type was the same as at the Makeevka Works, i.e., a checkered roller, and the other was with a toothed surface (Fig. 1). When the toothed roller was used for ragging the roll, no longitudinal groves were cut.

In the course of operation, the desirability of ragging the working surface of the rolls has been confirmed. Previously, slipping of the slab in the edge passes occurred frequently at our blooming mill and resulted in shocks in the roll-spindle-electric motor line. The slippage prolongs the rolling process and, hence, affects the output of the mill adversely; in addition, the quality of the surface of the rolled piece deteriorates because of large longitudinal tensile stresses which occur in the surface layers of the piece. Ragging eliminates slippage during rolling and improves the grip on the metal. In addition, with ragged rolls the drafts can be increased and the metal in heavy sections is more efficiently worked. Thus, by ragging the rolls for rolling 115 × 650 mm slabs from 1130 × 615 mm ingots it was possible to reduce the number of edging passes in the first groove from 5 to 4. The drafts increased from 90-100 mm to 110-120 mm.

Cracks rarely occur on the ragged surface of rolls and are considerably smaller in size than the cracks on smooth rolls.

The advantageous effect of the ragging on the resistance against crack formation manifests itself in the strengthening of the surface layer and the formation of a ragged contour of this layer. When heated or cooled, the projections on the ragged surface are not subject to compressive stresses due to the neighboring portions of the body (as is the case with a smooth surface) and they are deformed freely without the formation of cracks. At the same time, the projections protect the bulk of the metal underneath from rapid changes in stresses.

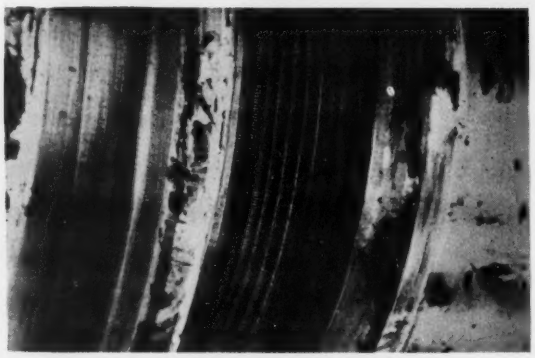

Fig. 2. Surface of the roll after ragging.

For an experimental rolling, we ragged the lower groove of the first pass of the blooming-mill roll with the checkered roller which had pyramidal projections, and the upper groove with a toothed roller (Fig. 2). It was found that the toothed surface has better gripping properties than the checkered for the checkered surface

[1] Metallurgist No. 9, 1957 and No. 8, 1958. See C. B. Translation.

has a larger number of interlinked ridges than the toothed one. The depth of the depressions on the toothed surface is 1.5-2.0 mm and on the checkered surface 2.0-2.5 mm.

An inspection of the surface of the grooves after the roll change showed that toothed ragging is more durable than waffle-pattern (checkered) ragging. This

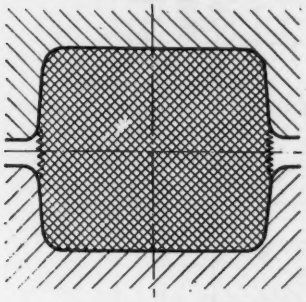

Fig. 3. Diagram showing the formation of defects on the surface of billets when they are rolled in waffle-pattern ragged grooves.

was quite evident when the surfaces of the upper and the lower grooves of the first pass were compared. The ragged surface was still not fully worn after 18 days of mill operation.

When billets of alloy steel were folled in passes with the waffle-pattern ragged surface, defects in the form of longitudinal cracks over the whole length of the billet were detected on the side surface of the billet. The use of unragged rolls for the prefinishing passes eliminated the formation of these defects.

The formation of the defects on the billet is explained by the fact that in the course of going through the pass, the transverse projections and depressions are rolled out and the longitudinal ones are compressed. A sort of corrugation appears on the surface of the billet between the collars (Fig. 3). These defects were not found when grooves with a toothed surface were employed.

On comparing the types of roll ragging which are in use (at the Makeevka, Alchevsk and "Azovstal'" Works), we may conclude that ragging the rolls with a toothed roller and without machining them longitudinally is the most rational method.

Ragging the rolls with a toothed roller after the preliminary longitudinal machining lies, most probably, between the two other types of ragging with respect to the gripping properties. With respect to strength, this type of ragging is inferior to the other two.

The resistance to crack formation, the gripping of the rolled piece by the rolls and the formation of surface defects on the rolled metal as well as the extent of the breakdown of the furnace scale and the prevention of scale slipping over the working surface of the roll, depend, in the end, on the shape and dimensions of the cross section of the ragging pattern.

SHORT-FLAME HIGH-PRESSURE BURNER

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Laboratory of Metallurgical Heat Engineering at the Magnitogorsk Metallurgical Combine

The thick-plate mill is served by regenerative chamber furnaces with 3.5 × 8.5 m removable hearth of the H-I' type; only air is heated in the regenerators. The furnaces are used for heating ingots and billets of 9, 10.5 and 12 tons, and slabs of 4-5.5 tons. The furnaces were designed for burning mixed gas (blast-furnace and coke-oven) of 2200-2500 kcal/m^3 calorific value. The maximum heat release is 7.5-8.0 million kcal/hr (Fig.1).

Because of the shortage of mixed gases, the Magnitogorsk Branch of the Gipromez recently prepared a project of furnace modification involving a change to fuel oil. In accordance with the project, the furnaces were provided with 10 (5 on each side) high-pressure burners of double straight-stream atomization (Fig. 2) and 125 kg/hr fuel consumption; steam at 5-7 atm pressure was used for atomizing the fuel.

Fuel conditioning was provided in order to ensure a smooth operation of the burners and regulators. A rough purification and heating of the fuel oil is effected with sieve filters and a heater which are installed in front of each furnace (two filters per furnace). RDP-4 pressure regulators are installed in front of the furnaces to provide a constant fuel pressure. Especially thorough treatment in the design was accorded to cleaning, heating and controlling the fuel oil with the object of arranging an optimum regime of furnace operation and the control of fuel consumption. Each furnace was provided with a PPÉ-type flowmeter. All fuel oil lines to the burners were laid together with the steam lines.

For a check of the operation and the control of the process, the furnace is provided with the following autocontrol, regulation, and signalling equipment assembled on the thermal control panels of each furnace: a) for the measuring and automatic control of the temperature in the working space of the furnace and for measuring the temperature of the air and flue gases; b) for metering

the gas, fuel oil, and air flow and for the automatic control of their proportions; c) for measuring and regulating the pressure in the working space of the furnace; d) for controlling the pressure of the fuel oil. In addition, there is a Ney valve-change unit for fuel oil and steam.

In the modified design, 10 combustion chambers of the old dimensions, as before, were retained: length 472 mm, width 1298 mm, and height 490 mm (Fig. 3). The only change was in setting the ducts of the gas burners further apart and in installing a third duct for the atomizer.

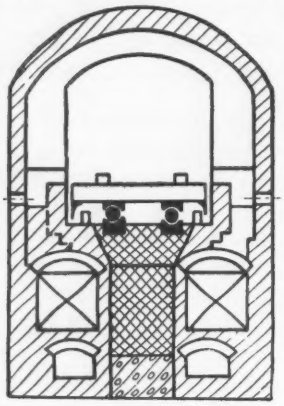


Fig. 1. Section through the furnace for heating ingots and slabs.

Since the combustion chambers are not long (472 mm), upon leaving the straight-stream atomizing burner, the fuel oil has no time for the complete atomization and combustion. On striking the opposite wall of the combustion chamber, the broken up drops of oil coagulate into larger drops which again are dislodged by the steam. As

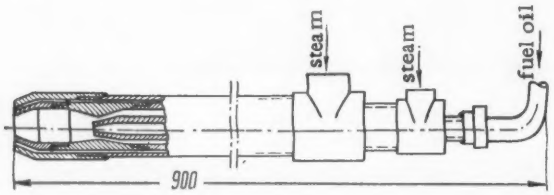


Fig. 2. Burner with straight-stream double atomization.

a result, the combustion is accompanied by the evolution of soot and the furnace produces a copious smoke. With five atomizers operating, not more than 150-175 kg of fuel oil per hour could be fired in the furnace at a maximum rate of steam supply for atomizing of 5-6 atm pressure of the steam in the mains. When the fuel rate was increased, the furnace began to smoke copiously. The design rate of the fuel oil combustion is 600 kg/hr.

With the object of improving the combustion of the fuel oil in the combustion chamber, the author developed a single-step, short-flame, high-pressure burner with a swirl tip (Fig. 4), of 150 kg/hr fuel rate.

The body of the burner is welded from tubes $\frac{1}{2}$ inch and $\frac{1}{4}$ inch in diameter. The fuel oil nozzle (4) is made

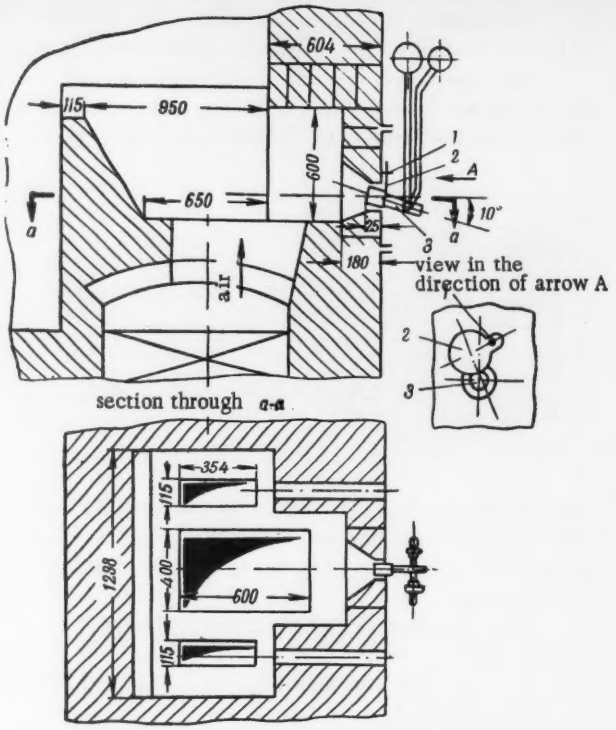


Fig. 3. Combustion chamber of the short-flame burner: 1) Axis of the shutter; 2) shutter; 3) burner.

in one piece with the swirl tip and is welded to the fuel oil pipe (5). The steam nozzle (2) is threaded and is screwed onto the steam pipe. The steam and fuel feed lines are concentric. The pipes carrying the steam and the fuel are connected to the burner by means of special unions (Fig. 4,b) which permit the burner to be set at any angle. Upon turning the burner through 180°, once can unscrew the steam nozzle, clean the swirl tip or replace the steam nozzle on the spot. The spread angle of the oil flame is 50-60°; with the double-atomizing burner it is 15-20° and, therefore, the flame is wide and soft.

The burner works satisfactorily at an average stream pressure of 2.5-3.0 atm and this feature is very valuable since the pressure of the steam in the mains fluctuates. The burners in the regenerative furnaces are operated intermittently, i.e., they work under more rigorous conditions than the burners in the nonreversible furnaces and in boilers. Having small gaps (1 mm) at the outlet between the steam and oil nozzles, the double-atomizing burners frequently burn through and become unusable. With the burners with the swirl tip this happens very rarely.

We have also changed the design of the combustion chamber (Figs. 3 and 5); the volume of the chamber was increased at the expense of the trenches (the opposite wall of the chamber). For reducing the burn-through of the trenches and directing the flame better, the trenches were made at an angle. Because of the wide angle of spread of the flame, an additional forechamber with an arched

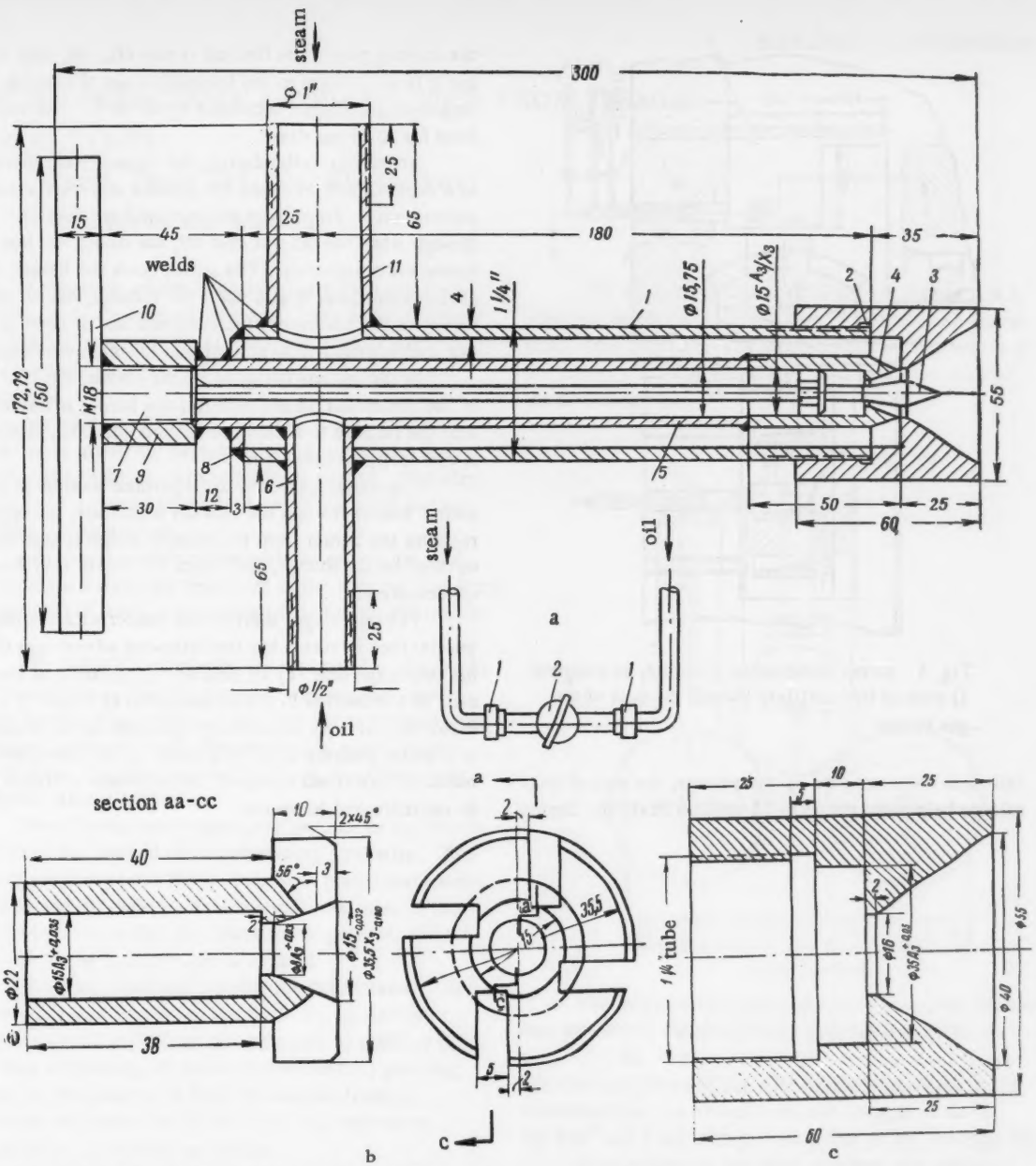


Fig. 4. Short-flame burner with swirl tip: 1) $1\frac{1}{4}$ inch watergas pipe; 2) steam nozzle; 3) needle; 4) fuel oil nozzle; 5) $\frac{1}{2}$ inch watergas pipe; 6) $\frac{1}{2}$ inch branch pipe; 7) needle thread; 8) end flange; 9) nut; 10) needle handle; 11) 1 inch branch pipe; a) method of mounting the burner: 1) special unions; 2) burner; b) fuel oil nozzle; c) steam nozzle.

roof was made in the wall brickwork; the forechamber is 424 mm long, 500 mm wide, and 600 mm high.

With the object of increasing the air supply to the base of the oil flame, the cross-sectional area of the air duct carrying air from the regenerator was increased from 236 x 354 mm to 400 x 600 mm. The additional forechamber and the enlarged air duct made it possible to atomize the oil efficiently and ignite it at the exit from the burner.

After No. 7 furnace was equipped with the new burners and forechamber the rate of fuel firing increased to 1000 kg of fuel oil per hour. The flame is wide, soft and steady, and there is no smoke.

At present, a design for converting the boiler plant to fuel oil using short-flame burners with a tangential atomizer feed is being developed. All chamber furnaces at the MMC are now equipped with these burners. The fuel oil is used only during the heating period of the

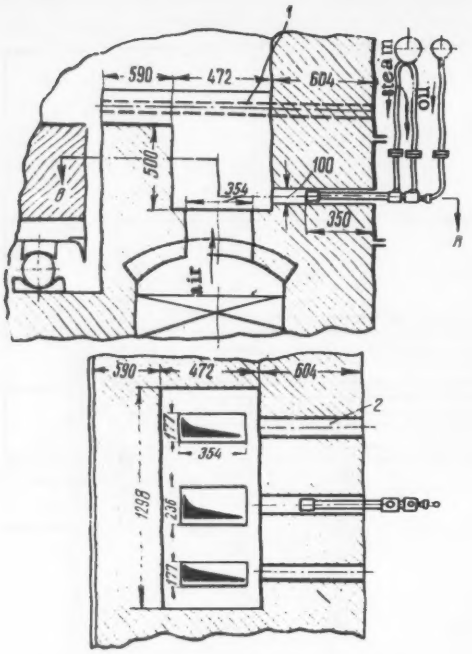


Fig. 5. Burner combustion chamber, as designed: 1) duct of the auxiliary burner; 2) duct of the gas burner.

billets in order to speed up the process, the rate of heat release being brought up to 13 million kcal/hr. During the soaking period the fuel oil is shut off, and only the gas is fired. Owing to the intensification of heating, the output of the furnace increased by 15-20%. The oil is fired for 12 hr per day.

According to the design, the burners were inserted to a depth of 350 mm into the furnace and were mounted permanently. To prevent the burners from burning-through when the oil was shut off, the steam was not turned off completely. The steam cools the burner, but, at the same time, it also cools the furnace, has an adverse effect on the brickwork, increases the loss of steel in burning, and contributes to an increase in steam consumption.

In the burners designed by the author, the feed lines of the steam and oil are coaxial; the burner is inserted into the furnace to a depth of 25 mm only and, therefore, it can easily be taken out.

The author proposed to fit pivoted shutters to the burner windows; when the fuel oil is shut off, the operator removes the burner from the window which is then tightly covered by the shutter, and hence the steam may be shut off completely.

The one-stage, short-flame burner with the tangential feed of steam has the following advantages over the two-stage one: a) an efficient combustion of fuel oil; b) a reduction in the consumption of steam by a factor of 2.5; c) a satisfactory operation of the burner at a steam pressure of 2.5-3.0 atm; d) the one-stage burner is five times cheaper; e) the burner is simple to assemble and to operate.

THE MANUFACTURE OF RIVET WIRE FROM 30KhGSA ALLOY STEEL

Cand. Tech. Sci. Ya. Kh. Sartan

"Proletarskii trud" Works

Rivets made of the 30KhGSA alloy steel are used extensively in the aircraft industry. They have to comply with special requirements with respect to their strength. The rivets are made by cold upsetting from sized cold-drawn wire.

According to ChMTU* 5615-56 the wire supplied should be in a slightly hardened state having been previously annealed to a state of granular perlite. The wire should have a tensile strength of 50-75 kg/ mm² and not less than 8% elongation.

Additional specifications with respect to the wire rod stipulate a thorough treatment of the wire rod involving the removal of scabs, cracks, seams, and other surface defects.

The 30KhGSA-steel wire rod, received at the Works to be cold drawn, exhibits varied microstructure, even in one batch. The surface of the wire rod is covered with a compact layer of scale, the removal of which by the conventional chemical method (picking in sulfuric acid solutions) takes a long time.

These factors were taken into account in the development of the method of manufacturing rivet wire. The process adopted at our Works includes a preliminary scale removal and the intermediate thermal treatment of the drawn wire rod, so that the formation of granular perlite structure in the finished wire is ensured.

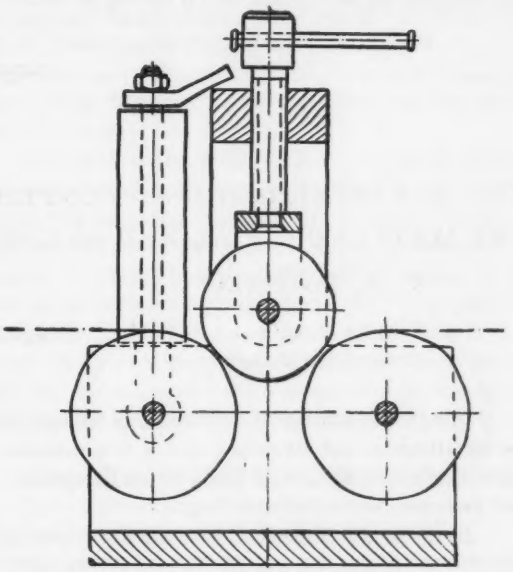
The total process of making the "chromansil" wire of specified size consists of the following operations: a) removing the scale from the wire rod; b) pickling the wire rod; c) drawing; d) thermal treatment; e) pickling; f) drawing the wire to its final dimensions (sizing); g) testing and inspection by the OTK; h) lubrication and packing; i) delivery to storage.

The thinner the wire, the more times are the drawing, thermal treatment, and pickling repeated.

The removal of scale from the surface of the wire rod is effected by means of a special roller apparatus – a scale breaker (see drawing) – mounted directly at the drawing block. The removal of the scale makes it possible to reduce the duration of the pickling operation considerably.

Our operational experience indicates that wire rod from which the scale has been removed should be pickled in a 18-8% sulfuric acid solution for 8-15 min. Water rinsing and lime cooling are carried out in the usual way according to the method adopted at the Works. After thermal treatment, the wire should be pickled for 8-10 min.

The wire rod is drawn at 30-50% draft and this is adequate to obtain a surface free of cavities and coarseness. This condition provides the basis for the choice of the initial size of the wire rod for drawing the wire of the size required.



Scale breaker.

The final drawing (sizing) takes place after the thermal treatment, the draft being maintained within the range of 5-6%. Such a small draft ensures that the mechanical properties of the wire obtained conform to the specifications: an ultimate tensile strength of 50-75 kg/ mm² and a percentage elongation of not less than 8%.

As an example, we shall describe the procedure of drawing wire 9.8 and 5.2 mm in diameter.

Drawing 9.8 mm wire.

1. Drawing 12.0 mm wire rod to 10.05 mm (30% draft) on a 1/ 600 or 1/ 700 drawing machine in one pass at a speed of 50 m/ min.

2. Sizing the wire from 10.05 mm diameter to 9.8 mm diameter (5.0% draft) on the same machine.

Drawing 5.2 mm wire

1. Drawing 7.0 mm wire rod to 5.35 mm wire on a 1/ 6000 or 1/ 7000 drawing machine in two passes (total draft 42%).

2. Sizing the wire from 5.35 to 5.2 mm diameter on the same machine (5.5%) draft.

* Technical Specifications for Ferrous Metallurgy.

The wire is subjected to thermal treatment in electric furnaces, type ShO-130, the weight of a charge being 850-1750 kg.

Before the wire rod is passed on for processing, 3 samples for selective tests on microstructure are taken from each charge (850-1750 kg). Depending on the initial microstructure of the wire rod, there are two regimes of thermal treatment to obtain the granular perlite structure.

If the wire rod has a granular perlite structure, the following regime is applied:

a) heating the wire rod to 680°; b) keeping it at that temperature for 2.5-4.5* hr; c) cooling it to 670°C in the furnace; d) heating to 700°C; e) keeping it at that temperature for 2.0-4.0* hr; f) cooling it to 650°C in the furnace; g) cooling it down further in pits.

To check the microstructure and mechanical properties of the thermally treated wire rod, samples are taken in every charge from each end of three coils placed in different positions in the furnace (bottom, middle and top).

The adopted regimes of the thermal treatment ensure the formation of granular perlite in wire rod of 50-63 kg/ mm^2 tensile strength.

The accepted method has been used for a long time for the production of rivet wire from the 30KhGSA steel at the "Proletarskii trud" Works.

The wire produced fully satisfies the ChMTU 5615-56 specifications with respect to the mechanical and processing properties as well as to the microstructure.

THE IIIrd INTERNATIONAL CONFERENCE OF WORKERS OF THE METALLURGICAL AND MACHINE-BUILDING INDUSTRIES

V. A. Podzerko*

* Leader of the Soviet Trade Union Delegation of Metallurgical and Machine-Construction Workers

The IIIrd International Conference of Workers of the Metallurgical and Machine-Building Industries, in which Conference the Soviet Trade-Union delegation took part, was held recently in Prague.

Metallurgical workers all over the world were kept fully informed in advance about the forthcoming Conference and took great interest in it. 166 delegates from 38 countries representing about 13 million workers took part in the Conference.

The Conference had the following problems on its agenda:

1) The work of the International Association of Trade Unions on fostering brotherly cooperation and unity of action in the trade unions of workers in the metallurgical and machine industries, in their fight for a higher standard of living with improved working conditions and shorter working hours, against the social repercussions of automation, for the preservation of peace and the expansion of trade-union and democratic rights;

2) the tasks of the trade unions of workers of the metallurgical and the machine industries in the fight for national independence; the industrialization and economic development of the underdeveloped countries and an improvement in the living standard of workers;

3) report of the Mandate Commission;

4) election of the governing bodies of the IATU (International Association of Trade Unions).

The program of the Conference also included meetings of branch Commissions in the main branches; shipbuilding, motor, iron and steel, electrical and general machine-construction industries.

The Conference was opened by the Chairman of the IATU, Comrade D. Roveda (Italy). Comrade Zupka, the Chairman of the Central Council of the Trade Unions in Czechoslovakia, greeted the Conference on behalf of the trade unions of the Czechoslovak Republic.

Comrade Giacomo Adduci, the Secretary General of the IATU, addressed the Conference. He described in detail the results of the struggle of metallurgical workers for the past 4 years since the IInd International Conference held in Vienna. In its work, the IATU was guided by the directives and resolutions of the IInd International Trade Union Conference. Comrade Adduci pointed out that it was necessary to strengthen the unity of action and the solidarity of metallurgical workers and their trade unions still further in order to fight successfully for increased pay, shorter working hours, the preservation of trade union rights and privileges, the preservation of peace and the cessation of war in the whole world, a ban on the nuclear bomb and on nuclear bomb tests, against exploitation, against partial or full unemployment, and the social repercussions of automation. The International Association of Trade Unions of Metallurgical and Machine-Construction Workers always supported every initiative coming from the World Federation of Trade

* The shorter time refers to the smaller charge (850 kg), and the longer time to the larger charge (1750 kg).

Unions. Workers should show appreciation to the WFTU for the effective part it played as a champion of peace and progress.

The International Association of Trade Unions of Metallurgical Workers supported the idea of arranging a conference of workers and trade unions of European countries for peace and against the threat of atomic war (Berlin, June 20-22) and declared itself in full agreement with the resolutions of the International Congress in Stockholm for disarmament and international cooperation, as well as with the resolutions of the Tokyo Congress against the use of atom and hydrogen bombs. Under the guidance of the IATU the metallurgical workers achieved definite successes in the difficult struggle. The main success was the fact that, as Comrade Adduci said, "We strengthened international solidarity and contributed to the fight for the preservation of democratic liberties and peace." A number of measures aimed at supporting the economic and social demands of the metallurgical workers were carried out. Comrade Adduci gave several examples, illustrating the successes achieved. Thus, in France, the metallurgical workers carried out 15,000 measures aimed at an improvement in pay in the course of two years.

By a persevering fight, the workers of Schleswig-Holstein in the German Federal Republic forced the parliament to pass the law of the new system of sickness benefit payments. In Italy, it was possible to achieve solidarity of action of separate trade unions and to achieve a reduction in working hours by 80 hr per year without a reduction in wages.

After stressing the successes achieved in all fields in socialist countries, the speaker passed on to discuss the economic depression in the U. S. A. and its repercussions in other capitalist countries

He gave a thorough analysis of the economic statistics of the basic branches of the metallurgical and machine-construction industries of various countries, a description of the position of the workers employed in those industries, and the specific problems and requirements confronting the metallurgical workers.

A considerable part of the Secretary General's speech was devoted to the problem of automation and the struggle against its adverse effects in capitalist countries.

In conclusion, he outlined the main goals at which metallurgical and machine-construction workers should direct their struggle in the future, and in particular, stressed the urgent need for cooperation and solidarity between national and international labor organizations. "Unity is the key to success" - said Comrade Adduci.

An extensive discussion followed the speech.

Comrade L. Maskarello (France) said that the French government had learned nothing from the seven-year war in Vietnam and were again dragging the country into the dirty adventure in Algeria. Soon it would be 4 years since the workers started to carry the burden of that war. The war had become more and more ruthless, the expenses of the war were increasing, and the prices of essential goods were rising. While industrial output in 1957 had increased, this had taken place only at the expense of the exploitation of the workers, an intensification of work and longer working hours. Frequently, the working week exceeded 50 hours. The workers replied to this policy with strikes. In 1957, over a million metallurgical workers took part in strikes and achieved a 3-7% increase in pay.

Comrade Lama, the Secretary General of the Federation of Workers of the Metallurgical and Machine-Construction Industries in Italy, raised the question of the protection of workers interests from the actions of the international organizations: The European Common Market and the Coal and Steel Federation. He made an apeal for the admission of such large labor organizations in Italy and France as VKT* and VIKT** (Affiliated to the World Federation of Trade Unions), to these International Organizations (ECM and CSF) in order to be in a position from within these organizations to protect the interests of the workers.

Comrade Mansur Abdul Muneim, Chairman of the Federation of Electricians in the United Arab Republic, said: "We broke the chains which the English, French and Americans had put on us. Utilizing the natural resources of the country, the established government leads the nation toward industrialization." This is the guarantee for raising the living standards of the workers in the UAR. The speaker pointed out that the metallurgical industry was established in his country for the first time; an extensive electrification of the country was being planned.

Comrade Labros (Cyprus) described the structure of the trade union organizations in Cyprus and showed their qualitative and quantitative growth. Reporting in detail the activities of the Corporation of the Workers of the Machine-Construction and Electrical Industries, he pointed out that whereas in 1954 the Corporation had 634 members, at present the membership has increased by a factory of 2,5. The speaker mentioned the low standard of living among workers in Cyprus, described the difficult situation in which the trade union had to fight for shorter working hours, for overtime pay, for holidays with pay, for a higher standard of living and higher pay. During the May-day demonstration in 1958, 50,000 people resolutely demanded the abolition of the concentration camps, the end of the emergency, improved social services and wider trade-union rights, cessation of nuclear tests, a summit conference, and a stable and permanent peace.

Comrade Matuso (Japan) said that as a result of the introduction of the American system of management at large establishments, the intensification of labor had increased, the prices on consumer goods had risen, the living standards of workers had fallen, and the profits of the capitalists had risen fantastically. The introduction

* General Confederation of Labor.
** General Confederation of Labor in Italy.

of automation and mechanization had resulted in the elimination of a large number of small and medium-sized firms, the replacement of skilled workers by unskilled ones, the discharge of women (in particular married ones) and their replacement by juveniles. In these circumstances, under the guidance of the Central Council of Japanese Trade Unions (SOHO), the workers were fighting resolutely for better living conditions and for the protection and extension of democratic rights and liberties. On several occasions, the workers succeeded in obtaining an increase in pay.

Comrade Romala (Madagascar) declared that at that time many families in Madagascar were suffering death from starvation. Unemployment had reached 20-30%. But even under those difficult conditions, the workers were fighting vigorously for their rights.

In his speech Comrade Ellias (West Bengal) presented a picture of the economic, social, and political position of workers in the whole world; he told the Conference about the struggle of underdeveloped countries for their national independence and about the part played by the metallurgical and machine-construction workers in that struggle. He held up to shame the colonizers and monopolists who try by every means to retard the industrialization of backward countries, by buying their raw materials at low prices and selling them the finished products at exorbitant prices.

The speaker stressed that all the nations of the underdeveloped countries strive toward political independence and fight against colonialism. They must be given the right of self-determination and the use of national resources in the interest of their own countries. These countries must have markets for their raw materials, they must strive for international solidarity and economic help from the industrially developed countries, and for a higher purchasing power among the working people.

In the discussion after Comrade Ellias' speech, the delegates from the socialist countries reported a further improvement in the economy, culture, and living standards of the people in their countries; and spoke about the unselfish economic help for the underdeveloped countries.

The Dutch delegate, R. Backer (EWTS-1958) made an appeal for a fight for the expansion of trade between the Netherlands and the countries of the socialist block against the submission of the Dutch economy to the dictate of the West German magnates and real economic help for underdeveloped countries.

Comrade L. Torezira (Venezuela) said: "Metallurgical workers in Venezuela have to suffer strong competition. The country is flooded with the products of the metallurgical industry of western countries, above all of the USA." To protect the national industry of Venezuela, a powerful movement led by the Association for National Industry came into being. The movement has the support of the whole population.

Louis Saiyan, the Secretary General of the World Federation of Trade Unions (WFTU), delivered a long address. He stressed the quantitative and qualitative growth of the International Association of the Trade Unions of Metallurgical Workers and pointed out that the work of the IATUMW is closely linked with the activities of the WFTU but this does not mean that the IATUMW follows the WFTU blindly. It always puts forward its opinions, remarks, and suggestions.

The Secretary General dealt with the problems of automation. He pointed out that automation should not be treated as merely the question of introducing a new technique; one must consider the consequences of automation in the capitalist countries. Monopolies endeavor to use automation for their own interest although they screen themselves behind false declarations about imaginary national capitalism. A resolute and persistent fight must be waged against such consequences.

Louis Saiyan analyzed the possibility of a solidarity of action based on the fight for concrete and definite demands. "Unity is a struggle, a necessity, a need. It is not an aim in itself, but a means which will help in achieving great successes in our struggle."

The Conference unanimously passed the following resolutions.

The resolution on the activities of the International Association in fostering a brotherly cooperation and unity of action among the trade unions of metallurgical and machine-construction workers.

The resolution on the struggle of the workers of the metallurgical and machine-construction industries in underdeveloped countries for national independence, industrialization, and improved living and working conditions.

The resolution on the problem of automation.

The resolution of the European Common Market.

The resolution regarding the establishment of separate international commissions for individual branches of industry and the approval of the recommendations proposed at conferences in those branches.

The resolution on the exchange of delegations and cooperation between trade unions.

A resolution on the question of peace preservation, disarmament, and the discontinuation of atomic tests.

The letter to American workers and several other documents.

The Conference unanimously elected new members to the Administrative Committee—the governing body of the IATUMW. Comrade L. Maskarello (France) became the chairman and Comrade G. Adduci (Italy) became the Secretary General. The former chairman, Comrade Roveda, was elected honorary chairman of the Internation Association.

The work of the conference took place in an atmosphere of complete unanimity in spite of the different nationalities of the delegates.

75th ANNIVERSARY OF THE "SERP I MOLOT" WORKS

N. P. Zhetvin and L. N. Podvoiskii

In February, 1884, a rolling mill was put into operation at the Rogozha Gate in Moscow. This was the beginning of the present "Serp i molot" Works. The new establishment was the property of the "Society of Moscow Metal Works," in which the main shareholder was a foreign capitalist, Gujon. The works inspector wrote in his report: "...The works is accommodated under an open shed on stone columns. During the winter, boards are placed in the gaps between the columns..."

The Works employed 200 men working in two shifts which made up a 24 hr day.

There was no mechanization at the Works. Even later on, when Gujon built open-hearth furnaces (the first 7-ton open-hearth furnace was put into operation in 1890), a rolling mill, a metal-construction shop and a plate-rolling mill, mechanization was still absent. The transportation of the charge materials to the furnaces and most of the charging operations were done by hand. Hot ingots were brought on trolleys from the furnaces to the mills. At the drawing plant the strength of acid solutions was tested "by tongue". Women doing the same work as men were paid half as much.

Before the Revolution the Works produced roofing iron, nails, bolts, shoe studs, simple castings, and iron structures.

The unbearably hard working conditions and the ruthless exploitation aroused protests from the workers. As early as 1894, the first Marxist group was founded at the Works. The first victim of the February Revolution was Gujon's worker, Illarion Astakhov, whose name was given to a Moscow bridge over the Auza River. Some veterans of the Revolution and the Civil War, A. E. Treshchalov, G. I. Galeev, V. E. Ob'edkov, and others retired not very long ago.

As a result of the Civil War and the devastations in 1920, production at the Works almost completely ceased. The workers were at the front or dispersed in villages. Even before the end of the Civil War, the Bolsheviks began the reconstruction of the Works. I. R. Burdachev, a fitter, was appointed the first communist director. In 1922, at a meeting, the 1500 workers passed a resolution to call the works "Serp i molot". It was entered in the minutes that this name was very fitting for the Works since "serp" (sickel) means the tool of peasants and "molot" (hammer) is the tool of workers".

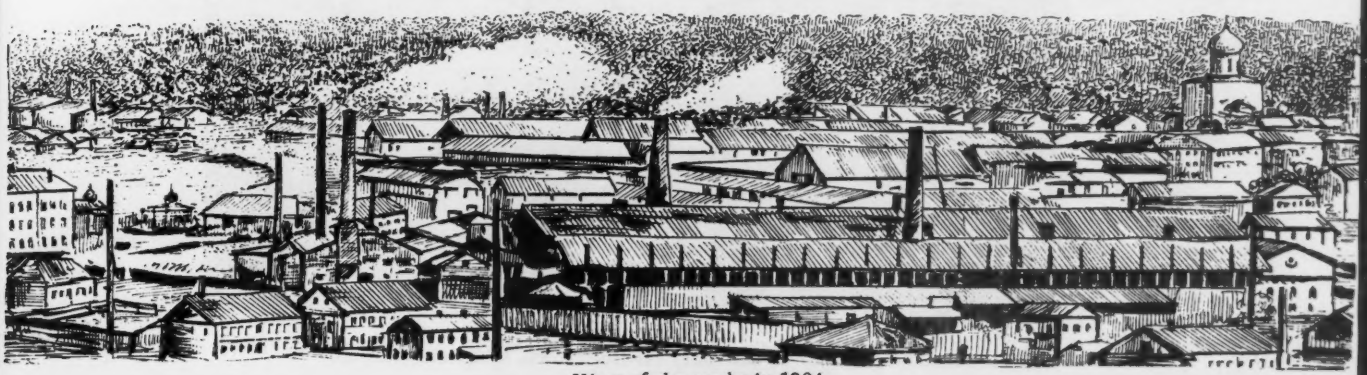
Guided by the Party, the personnel of the Works rapidly restored the devastated establishment, and, in 1929, began radical reconstruction involving a switch to the production of quality steel.

The "Serp i molot" Works pioneered the production of various forms of high quality steel: sized ball-bearing steel, stainless strip, high-speed silver steel, high-manganese castings, etc.

The appearance of the Works changed beyond recognition. Not without reason do the workers joke that "only one pipe of old Gujon's remained at the 'Serp i molot' Works, but even that one bent away". The area on the Works doubled; new shops were built; a foundry, a rope plant, a repair and machine shop, a plate finishing shop, and other shops. The old shops were extended substantially; they were provided with better equipment, the processes were mechanized and automated, and the workers' duties were made easier.

Over a thousand factories in Moscow and other towns are supplied by the "Serp i molot" Works with quality and high-quality steel: stainless and heat resistant plates and strips, manganese castings, ball bearing steel, etc.

The names of the leading workers of the "Serp i molot" Works are widely known in our country. The organizer of the first shock team at the plate-rolling mill in 1929 was mill operator Arsentii Gladyshev, who



View of the works in 1894.

was awarded the No. 1 Order of the Red Banner of Labor. In 1933 the first Komsomol member – steel melter Gavriil Sviridov was awarded the Lenin order.

In the thirties the "Serp i molot" Works began the struggle to master rapid steel-melting methods. Steel melters I. Lysakov, L. Povalyaev, P. Sveshnikov, E. Kochetkov, G. Cherepanov, T. Greveshkov, and others were some of the first in the country to start making steel by speeded up methods. Engineer M. Korolev, furnace foreman G. Il'in (who later on became the director of the Works) and foreman S. Chesnokov carried out the modernization of the furnaces and organized repair operations in a new way, thus contributing greatly toward an increase in the productivity of the steelmaking units. In 1933, the open-hearth shop won the Red Banner prize offered by the newspaper "Pravda", and since then it has remained one of the best steelmaking shops in the USSR with respect to daily output. It was the first plant where oxygen for speeding up the open-hearth process began to be used on a commercial scale. A group of engineers from this Works, led by Academician I. P. Bardin, was awarded the Stalin Prize, 1st Class, for the development and introduction of this method. On the initiative of the Komsomol members, steel melters A. Subbotin and V. Mikhailov, a patriotic movement for increasing the life of open-hearth furnaces was started at that shop.

For the successful mastering of the production of quality steel, the "Serp i molot" Works was awarded the Lenin Order in 1939. Under difficult conditions during the war, the "Serp i molot" Works supplied the armed forces with steel and successfully fulfilled the tasks assigned by the State Defense Council.

For fulfilling these tasks, the Works was awarded the Red Banner of Labor in 1945.

The rolling mill operators do not lag behind the steel melters. The foremen, I. Turtanov and I. Romanov, who for over 20 years have been in charge of the main

Arsentii Gladyshev, the organizer of the first shock brigade in the plate rolling mill.

units in the section and the plate mills of the Works are well known among metallurgical workers in our country.

The personnel of the "Serp i molot" Works is its most valuable asset. Thanks to the personnel, for twenty-five years, year in year out, quarter after quarter, the Works has more than fulfilled the state plans, it has produced thousands of tons of steel and rolled sections over and above the quota every year, and it has mastered the production of new steel grades and complex sections. Over 3000 workers and engineers at the Works have been awarded USSR orders and medals and, after having served at the Works for many years, have retired but recently. They have retained permanent entry passes to the Works.

The remarkable work of the personnel has ensured a continuous increase in output. During the Soviet re-

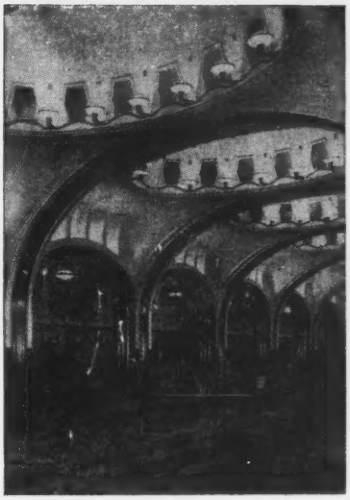
Oustanding workers of the "Serp i molot" Works (from left to right): M. A. Ustinov, V. N. Konnikov, N. M. Koshink, V. I. Dyuzhev, A. T. Ul'yushenkov, V. E. Serzhantov, and P. E. Pushkarskii.

gime, the gross output of the Works has increased by a factor of more than ten. In the whole of 1913, 7 open-hearth furnaces produced as much steel as is now produced in one year in one furnace at the No. 1 open-hearth plant. The output per worker has increased by a factor of 3.5 and, at the same time, it is not a simple metal for nails and shoe studs that is being produced but high-quality alloy steels for cars, agricultural machinery, lathes, aircraft, tools, etc.,

"A Worker and a Woman Worker from the Collective Farm", a sculpture by Makhina, made from stainless steel sheets rolled at the "Serp i molot" Works.

In the ten post-war years (1946-1956) the assortment of goods produced at the Works changed markedly. While the total output of rolled quality steel in that period increased by a factor of 2, the output of sized ball bearing steel increased by a factor of 4.5, stainless-steel sections by a factor of more than 22 and high-speed steel by a factor of more than 6. Up to 1946, the Works was producing neither high-speed silver steel, nor heat-resistant and stainless castings; now it makes hundreds of thousands of tons of these products annually. Operating efficiency increased during those years by a factor of more than 2.5.

The workers entered the competition to mark the XXIst Congress of the CPSU with great enthusiasm. In the course of this competition, the metallurgical workers revised their voluntarily accepted obligations three times and each time those obligations were met and even exceeded. By completing the 1958 plan ahead of schedule, the Moscow metallurgical workers produced thousands of tons of steel and rolled section over and above the plan.



"Mayakovskaya" Underground Station finished with stainless strip, rolled at the "Serp i molot" Works.

This was the answer of the workers to the care and attention shown by the Communist Party and the Soviet Government to the needs of metallurgical workers. Indeed, to make the duties of the workers easier in the last three years alone a hook conveyor has been built at the wire drawing plant and the tail end of one of the section mills has been mechanized. In 1958, the mold yard was put into use. At last, the "Gujon runner" which was the curse of steel pourers for about 70 years was done away with. Steel is now poured into molds on bogies.

At present, the Works is about to start a second radical modernization. According to the new Seven-Year Plan the output of steel and rolled product will not increase much, but the variety of products will be extended substantially, and there will be an increase in the output of stainless and heat-resistant steel, steel wire, silver steel and other types of high-quality product.

The Seven-Year Plan envisages the solution of another important problem: the end of the housing shortage. In the past 12 years, the "Serp i molot" Works has built 28 multistory houses. Whereas in 1957, 5,000 m^2 of floor area was given for dwellings, in 1958, the workers have been given over 20,000 m^2 floor area, and in 1959 it is planned to build houses amounting to 23,000 m^2 floor area.

The personnel of the "Serp i molot" Works have achieved great successes in the past 40 years. In the forthcoming seven-year period, the Moscow metallurgical workers will make a worthy contribution to the cause of building communism.

IInd PLENARY MEETING OF THE CENTRAL COMMITTEE OF THE TRADE UNION OF THE WORKERS OF THE METALLURGICAL INDUSTRY

The IInd Plenary Meeting discussed the speech of the Chairman of the Central Committee, V. A. Podzerko, on the subject: "The tasks of the trade unions of the metallurgical industry in connection with the thesis of N. S. Khrushchev's speech 'The planned figures for the development of the national economy of the USSR for 1959-1965' and the thesis of the Central Committee of the Communist Party and the Council of Ministers of the USSR 'On the strengthening of the link between school and life and on a further development of the national education system', "and the speech of a member of the Presidium of the Central Committee of the Trade Union, M. S. Kovarskii, "On the progress in carrying out the resolution of the Central Committee of the Communist Party and of the Council of Ministers of the USSR regarding the changing to a shorter working day and the introduction of a new remuneration system for the workers of the metallurgical industry, and on the tasks of the trade unions with respect to a further increase in productivity and an improvement in the remuneration system."

Leaders of trade unions, representatives of the Councils of National Economy, deputy directors and those engaged in productivity and remuneration problems took part in the work of the Plenary Meeting.

In his speech, Comrade V. A. Podzerko devoted his attention in particular to the development of the metallurgical industry which constitutes the basis for the development of all industries, and also described the tasks of trade unions with regard to the mobilization of metallurgical workers in order to carry out the tasks put before them by the Communist Party.

P. P. Lygun, a senior furnace attendant of the Dzerzhinskii Works and a Deputy to the Supreme Soviet of the USSR, V. N. Luk'yanov, a steel melter at the Nizhne-Tagil Metallurgical Combine and a Deputy to the Supreme Soviet of the USSR, A. F. Zdorovets, a miner of the Dzerzhinskii Mining Board, N. Ya. Eltarev, the Chairman of the Works Committee of the Makeevka Metallurgical Works, and others who took part in the discussion, enthusiastically approved the Planned Figures for the Development of the National Economy of the USSR for 1959-1965 and told the meeting about their experiences in organizing the socialist competition for the title of "The Team of Communist Labor".

It was noted at the meeting that, on the change-over to the shorter working day, a great deal had been done on systematizing the pay and establishing production norms, and that the percentage of the basic pay in the total earnings of the worker had increased substantially (from 45-58 to 66-79%). The difference between the pay of executives and workers was reduced; the workers' wages in the third quarter of 1958 increased by 16.1% compared with the first half of 1958.

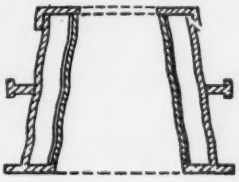
However, at some establishments and plants, ("Chiatur-Marganets" Trust, the Uzbek Metallurgical Works, several basic plants of the Petrovskii, Makeevka and "Azovstal'" Works) the increase in pay exceeds the increase in productivity; at some establishments there is a large number of workers who do not fulfil the assigned production norm.

In its resolution, the Plenary Meeting of the Central Committee put all the trade union organizations under an obligation to develop the socialist competition for higher productivity even more extensively, to support in every way the patriotic initiative of leading workers who join in the competition for the title "The Team of Communist Labor", and to resolutely endeavor to eliminate all shortcomings in production organization and the pay system. The trade unions should take an active part in the work connected with the change-over to the shorter working day and new pay conditions of the non-ferrous industry workers, they should intensify the control on safety arrangements in industry, intensify the educational activities of the workers and demand improved living conditions for the workers and the rest of the staff.

MORE ABOUT WAYS OF REDUCING THE WEIGHT OF INGOT HOT TOPS

The No. 8 issue of the "The Metallurgist" for 1958 contained an article on "advances made in the past 10-12 years in the reduction of the ingot hot top" by E. A. Iodko. In addition to the problems discussed in that article, one should consider the material of a meeting of British metallurgists.*

Several British works have successfully introduced a small size hot top of a complex shape (round-to-square design). The circular cross section of the upper end of the hot top ensures the lowest possible rate of metal solidification in the hot top, the rectangular lower cross section eliminates undesirable gaps between the base of the hot top and the mold (lapping over of shoulders).



Double-wall hot top.

Not infrequently one hears objections against covering the steel surface with lunkerite because of the fear that the carbon and aluminum content may be increased in the upper end of the ingot. Experiments carried out recently showed that there is no basis for such a fear, provided that a normal top discard is cut off; a uniform chemical composition of the steel is ensured even when most effective heat-insulating and exothermic mixtures are used for covering the surface of *the steel in the hot top.*

Abroad, successful use is made of a hot top consisting of a "double jacket" (Figure) which ensures a satisfactory mechanical strength of the hot top even when thin bricks (about 4.5 mm) are used, and therefore it is economic to make the lining from sillimanite or some other expensive, but highly refractory, material.

Since 1950, in the USA, for the purpose of reducing the top discard, hot tops made of insulating refractory of a lower thermal conductivity than that of firebrick have been used. Because of the low mechanical strength of the insulating firebrick, it is advantageous to use it in floating-type hot tops in which the firebrick is subject to smaller mechanical stresses. Owing to good insulating properties, the radiation losses are reduced; because of the relatively small cross-sectional area of the hot top, it is possible to reduce the volume of the hot top by 14% and this is especially effective in the case of alloy and high-carbon steels (0.6-0.8% C). The experience of American works has shown that in addition to a reduction in the top discards, the floating-type hot top eliminates transverse hanger cracks in ingots.

Investigations of the British Iron and Steel Institute on the standard firebrick hot tops (190 × 190 mm at the base and 127 × 127 mm at the top, 228 mm high, filled with steel up to a height of 203 mm) showed that, when the surface of the steel in the hot top (its weight = 14.7% of the ingot weight) was not covered, the necessary discard constituted 12.5%; the top discard decreased to 11% when the steel surface was covered with a 25 mm layer of vermiculite, it decreased to 9.7% when a 13 mm layer of an exothermic mixture was used, and to 8.7% when a 25 mm thick layer was laid. When the exothermic mixture was used not in the form of powder but in the form of a tamped mass, the end crop constituted 8.8%, a still greater reduction in the end crop (to 8.4%) was attained by the simultaneous use of the exothermic powders (13 mm thick layer) and vermiculite (25 mm thick layer).

On the basis of empirical data, the David Brown Co. (England) recommend square hot tops of 1 : 4 taper and a height to side ratio of 0.75, for high-alloy steel ingots in which it is very important to eliminate pipe formation. For mass production, especially in the case of steel of a narrow solidification temperature range, it is recommended that high, narrow hot tops of a nearly circular form, e.g., octagonal of a 1 : 12 taper and a height to diagonal ratio of 1.5, should be employed.

The Foundry Service Co. attaches great importance to the properties of the exothermic mixtures used for covering the steel surface in the hot top. If the ingot is over 152 mm wide, the use of cheap, rapidly burning thermite mixtures may cause the formation of bridges in the hot top. A reduction in the weight of the ingot top discard from 8% to 7% of the ingot weight can be achieved in large ingots by means of using slow-burning exothermic mixtures of low thermal capacity and good insulating properties. The best results are achieved when one uses exothermic mixtures which "coke" and form a "plug" in the narrow upper end of the hot top and protect the steel from oxidation. The consumption of exothermic materials for obtaining a flat surface on the hot top can be reduced by 60% if the hot top is made of thermally insulating materials; the exothermic mixtures are then used only for coating the surface which is in contact with the liquid steel.

* J. Iron and Steel Industry, July, 1958.

New Books

A. D. Kramarov. Electric Furnace Steelmaking.
Moscow, Metallurgizdat, 1958, 439 p.

In the first part of the book, the author discusses the physicochemical processes of electric furnace steelmaking: the basic laws of the process are given, the slag properties analyzed, and the processes in the oxidation of liquid steel, the removal of gas and sulfur from steel, and the deoxidation of steel are described. In the second part, "The technology of electric steelmaking" the author gives a detailed account of the properties and defects of structural steel and discusses methods of melting and pouring the electrically made structural steel. The author then describes the properties, defects, methods of melting and pouring stainless, ball-bearing and transformer steels. Separate chapters in the second part of the book are devoted to the steelmaking process of arc and induction coreless furnaces, complex processes, operating statistics of electric arc furnaces and the control of the process of making and pouring steel.

A. M. Samarin, Vacuum Metallurgy.
Moscow, Metallurgizdat, 1958, 36 p.

The booklet contains a description of methods of making steel in electric-arc and induction furnaces under vacuum. The effect of vacuum on the properties of transformer steel is discussed. The author devotes much attention to methods of treating liquid steel under vacuum and sealing the vacuum equipment. The design and the field of application of electric-resistance vacuum furnaces and the prospects of vacuum application in the steelmaking process are discussed.

The booklet may be useful to metallurgical engineers in industry and in research institutes.

I. G. Polovchenko. The Movement of Charge Materials and Gases in the Blast Furnace.
Khar'kov, Metallurgizdat, 1958, 162 p.

The book begins with a detailed critical survey of literature on the problem of the movement of charge materials and gases in the blast furnace. Then, the author's own investigations, carried out with the use of radioactive isotopes, are described. A detailed description is given of the properties of the charge materials in the blast-furnace process: their ability to absorb radioactive radiation, their specific weight and volumetric weight (weight of 1 m^3 of granular material). On the basis of these properties, the author makes deductions as to the possibility of studying the movement of charge materials and gases by means of radioactive isotopes.

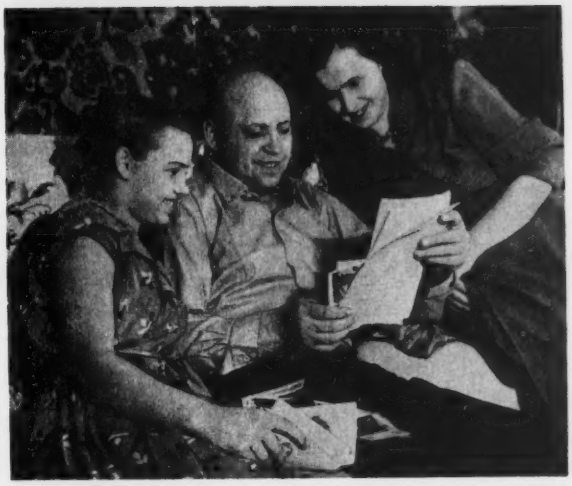
The third chapter of the book contains a description of the investigation method and the experimental results. The author reports interesting data on the movement of materials in the upper part of the stock, from the furnace top to the hearth, and below the air tuyeres. The next chapter contains a discussion of the relation between the movement of charge materials and the movement of the gas stream. The results of extensive investigations which show the correlation between the descent of the charge materials, the composition and pressure of the gas are presented and discussed.

The book is intended for scientists and technologists of research establishments and laboratories and may also be useful to production engineers.

SENIOR MILL OPERATOR IVAN ALEKSEEVICH SOMOV

Ivan Alekseevich Somov, a Hero of Socialist Labor, is well known to the workers at the KMC (Kuznetsk Metallurgical Combine). He has mastered his trade excellently and teaches young people successfully. The photograph below shows I. A. Somov with his son, Veniamin, who is assistant to the manipulator operator.

The skillful work of Ivan Alekseevich Somov was admired by a group of metallurgists from India who visited the Kuznetsk Metallurgical Combine. Top photograph (from right to left): I. A. Somov, Mukhundzhar Pandzhi, head of the rolling mill at the Bkhilai Works, Mr. Singh Dzhod, senior foreman of the same mill, and Mr. Sen Badzhoi, steel-rolling engineer.



I. A. Somov, together with a group of employees of the KMC, was sent to the Anshan Metallurgical Combine in China where, for seven months, he helped Chinese operators to adjust and start a blooming mill. For his work, he was awarded the Golden Medal of Chinese-Russian Friendship. During his stay in Anshan, Ivan Alekseevich made friends with Chinese metallurgists. Now he keeps up a lively correspondence with them. The photograph in the middle shows I. A. Somov, his wife, Klavdia Evseevna, and daughter, Larisa, reading a letter from China.

On his day off, Ivan Alekseevich Somov likes to play chess. Here, Veniamin Somov is no longer a pupil as at the mill, but assumes the role of teacher. He beats his father at chess frequently. In the photograph below we see the father and son at a game of chess. Alesha, the younger son, watches the game.

Photo D. Sholomovich

SIGNIFICANCE OF ABBREVIATIONS MOST FREQUENTLY

ENCOUNTERED IN SOVIET PERIODICALS

FIAN	Phys. Inst. Acad. Sci. USSR.
GDI	Water Power Inst.
GITI	State Sci.-Tech. Press
GITTL	State Tech. and Theor. Lit. Press
GONTI	State United Sci.-Tech. Press
Gosénergoizdat	State Power Engr. Press
Goskhimizdat	State Chem. Press
GOST	All-Union State Standard
GTTI	State Tech. and Theor. Lit. Press
IL	Foreign Lit. Press
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd. AN SSSR	Acad. Sci. USSR Press
Izd. MGU	Moscow State Univ. Press
LÉIIZhT	Leningrad Power Inst. of Railroad Engineering
LÉT	Leningrad Elec. Engr. School
LÉTI	Leningrad Electrotechnical Inst.
LÉTIIZhT	Leningrad Electrical Engineering Research Inst. of Railroad Engr.
Mashgiz	State Sci.-Tech. Press for Machine Construction Lit.
MÉP	Ministry of Electrotechnical Industry
MÉS	Ministry of Electrical Power Plants
MÉSÉP	Ministry of Electrical Power Plants and the Electrical Industry
MGU	Moscow State Univ.
MKhTi	Moscow Inst. Chem. Tech.
MOPI	Moscow Regional Pedagogical Inst.
MSP	Ministry of Industrial Construction
NIIZVUKSZAPIOI	Scientific Research Inst. of Sound Recording
NIKFI	Sci. Inst. of Modern Motion Picture Photography
ONTI	United Sci.-Tech. Press
OTI	Division of Technical Information
OTN	Div. Tech. Sci.
Stroiizdat	Construction Press
TOÉ	Association of Power Engineers
TsKTI	Central Research Inst. for Boilers and Turbines
TsNIÉL	Central Scientific Research Elec. Engr. Lab.
TsNIÉL-MÉS	Central Scientific Research Elec. Engr. Lab.-Ministry of Electric Power Plants
TsVTI	Central Office of Economic Information
UF	Ural Branch
VIÉSKh	All-Union Inst. of Rural Elec. Power Stations
VNIIM	All-Union Scientific Research Inst. of Meteorology
VNIIZhDT	All-Union Scientific Research Inst. of Railroad Engineering
VTI	All-Union Thermotech. Inst.
VZÉI	All-Union Power Correspondence Inst.

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us - Publisher.